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ABSTRACT

Planning, quality, and efficiency in universities are addressed in the proceedings of the 1984 forum of the European Association for Institutional Research. In addition to quality and efficiency in higher education, the 12 papers and 22 abstracts cover: evaluation of research and programs, the application of statistical techniques, strategic planning, entrepreneurial approaches, technology, and case studies of institutional research. Papers and authors include: "Planning for Quality and Efficiency in Higher Education" (Cameron Fincher); "Program Quality: Definition, Assessment, Enhancement" (Bas Savenije); "The Use of Bibliometric Data as Tools for University Research Policy" (H.F. Moed, W.J.M. Burger, J.G. Frankfort, A.F.J. van Raan); "Program Reviews, Planning, and Data Bases: The Experience of a Large University" (Edward A. Holdaway); "Mathematical and Statistical Modelling: The Careful Path Between Enthusiasm and Scepticism" (Claude Cossu); "Applying Robust Regression Techniques to Institutional Data" (Carlos Siau, Peter Rousseeuw, Annick Leroy); "Applying Strategic Planning in Academic Departments: Taking Charge of Change" (Sidney S. Micek); "The Impact of Institutional Research on Educational Decisions: Three Examples with Applications" (Poul Bonde); "Managing Financial Compression: One University's Experience" (Cynthia Hardy, Charles H. Belanger); "The Natural History of a Reorganization Project" (P. Verweel); "College and University Retrenchment: Its Impact on Non-Academic Revenue Sources" (Edwin R. Smith, Ben J. Tuchi); and "Technology Transfer from Universities into Industry" (L. J. Kail, P. J. Luther). (SW)

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Sixth European Forum of the Members of the Association for Institutional Research

Beyond Retrenchment : Planning for Quality and Efficiency

Proceedings

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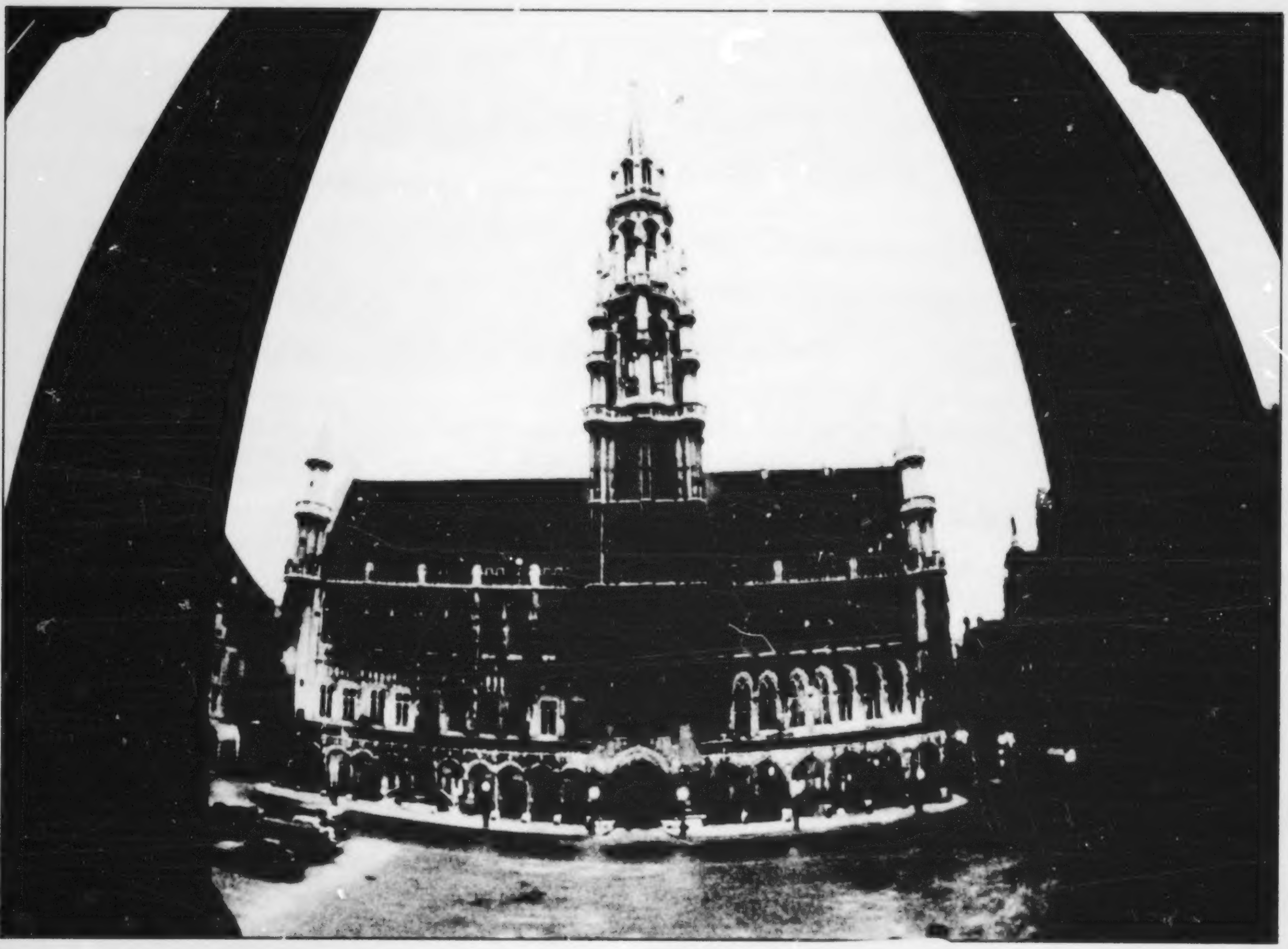

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BEYOND RETRENCHMENT:
PLANNING FOR QUALITY AND EFFICIENCY

CHARLES H. BÉLANGER, EDITOR

6th ANNUAL FORUM
EUROPEAN ASSOCIATION FOR INSTITUTIONAL RESEARCH
VRIJE UNIVERSITEIT BRUSSEL
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AUGUST 1984

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PREFACE AND ACKNOWLEDGEMENTS

The theme of this conference was about planning, quality, and efficiency in universities. These three concepts have often been greeted with mysticism and skepticism. Those of us who attended the Brussels meeting found nothing esoteric about the way presenters and participants interacted to define and apply the numerous shapes and forms of such realities. Although the Proceedings are an attempt to capture what went on during the conference, they fail to reflect the most important ingredient, its spirit.

Financial support received by the Belgian National Council for Research Policy, the Ministry of Education - Dutch Division, and the Vrije Universiteit Brussel added a special and appreciated touch to a solid organization and to the hospitality of the host country.

The work of the Local Arrangements Committee headed by Professor Franz Bingen was an example of planning and efficiency in action while the Program Committee, chaired by Dr. Frank Dijkman came up with a valiant effort to deliver quality presentations. They and their associates must be commended for a job well done. Secretariat persons are often unsung heroes of professional meetings. Under the coordination of Dr. Carlos Siau, they put their hearts and good skills into the task.

These Proceedings do not do justice to all presenters since they do not include all full papers. The readers made a selection on the basis of the following criteria: European relevance, significance of contribution, overall content quality, and technical requirements.

Special thanks are addressed to Ms. Laura Winer and Ms. Huguette Albert who respectively assisted with the editorial work and typed these Proceedings. Their dedication and thoroughness made my task easy.

Charles H. Bélanger

6th ANNUAL FORUM
EUROPEAN ASSOCIATION FOR INSTITUTIONAL RESEARCH
VRIJE UNIVERSITEIT BRUSSEL
BRUSSELS, BELGIUM
AUGUST 21-24, 1984

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1979 - **Institutional Research in North America and Europe**, Paris, France

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1981 - **The Pyramid of Decision and Other Approaches**, Louvain-la-Neuve, Belgium

1982 - **The Universities in a Changing World - Adaptation or Guidance**, Uppsala, Sweden

1983 - **The University as an Open System**, Maastricht, The Netherlands

1984 - **Beyond Retrenchment: Planning for Quality and Efficiency**, Brussels, Belgium

1985 - **Universities in the Melting Pot: IR as a Tool for Change**, Copenhagen, Danmark, August 21-23

1986 - Stratford, England (tentative)

1987 - Amsterdam, The Netherlands (tentative)

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PLANNING FOR QUALITY AND EFFICIENCY IN HIGHER EDUCATION

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Policy may be defined as an event, a process, or a product. As an event, policy may be a legislative enactment by a lawmaking body or it may be a choice between alternative modes of institutional operations or practices. As a process, policy may be a series of events that culminate in a widely held belief that shapes or influences future decisions and actions. And of course, policy may be the product of a concerted, sustained process -- a plan, blueprint, schedule, or calendar of events that specifies when and where certain events will take place.

But whether an event, process, or product, policy is central to whatever corporations, governments, and universities have in common. It is an abstraction that is indispensable in managing multinational corporations, in governing geographic/political divisions of society, and in administering educational institutions and programs. It is very much the encoding, instructing, directing, sustaining function upon which organizations, institutions, and societies are dependent for progressive and intelligible action. It is the computer program, software, or memory tape that facilitates intelligent decision or choice.

Planning in higher education displays in the 1980s a remarkable convergence with policy -- public, institutional, and educational! Policy can be viewed as the appropriate object of planning, and it is not inappropriately viewed as the object of educational research. Indeed, it is not inappropriate to define planning as the conscious, deliberate formulation of public, corporate, or institutional policy and the specification of means by which policy can be implemented. Thus, a policy-making process would appear to be a visible and common characteristic of all viable corporations, governments, and universities. Unfortunately for universities, however, their policy-making process is not as well defined or specified as the processes that can be observed in many business corporations or in many forms of national and/or regional planning. In too many colleges and universities, the planning or policy-making process remains a mystery to public leaders, elected or appointed officials, and the participants themselves.

The 1980s may someday be recalled as the decade in which there was the first genuine awareness or appreciation of the increasing interdependency of each nation's business corporations, government agencies, and institutions of higher education. This awareness has been brought about by the international competition that is evident in the production of automobiles, television sets, cassette recorders, cameras, and other feats of modern technology. Successful competition in international markets clearly implies planned cooperation among industry, business, government, and education. And it suggests an avid concern for both quality and efficiency in technological innovation and production. National policies of planned cooperation among business, government, and education may indeed be responsible for the competitive edge so often conceded Japan and the nations of western Europe by American businessmen.

Planning Purposes and Methods

The threat of international competition has produced, in the U.S.A., a strenuous criticism of public education and an intense advocacy of better planning. In 1983 alone, over nine different national commissions, panels, or task forces issued reports in which the quality of public schooling was criticized. Recommendations converged on a national need for better cooperation between schools and colleges, for strengthening the preparation of students entering college, and for ensuring standards of quality for both entry and progression in institutions of higher education. The last two or three years of high school and the first two years of college were seen as perilously close to disaster, and nothing less than extensive reform was seen as the solution. One of the national task forces was explicit in addressing its educational concerns to the nation's failures in international competition (ECS, 1983).

Planning is increasingly advocated as an effective means of adaptation to the changing environmental conditions that are so evident. This mode of planning, often identified as strategic planning, implies that institutions of higher education now function in a different climate or environment and must cope with changing demands that are primarily situational, external or contextual. As a style of planning, this mode is often silent about internal resources and developmental trends that operate from within. To some observers, there is thus a contradiction between adaptive planning that would accommodate environmental change and developmental theories that suggest an intrinsic unfolding of growth stages.

Carrying evolutionary metaphors to their full length, some theorists see a natural selection of institutions as a consequence of environmental competition. They speculate about developmental processes in which adaptable features or functions are reinforced and non-functional or non-adaptable features are selected out. Others cast institutional change in the mold of sociocultural evolution and suggest that institutions driven by knowledge, information, or technology have a different kind of propelling force or élan. The development of such institutions is not random or blind but planned-and-directed. The success or effectiveness of such institutions in dealing with environmental change is by no means natural; it is the result of a process that includes trial-and-error, experimentation, and deliberate variation in programs and services. Many such efforts are provisional in the sense that they introduce changes in programs or institutional practices that will eventually be retained or eliminated, depending on circumstances.

The Diversity of Methods

Although policy is a common characteristic of corporate, public, and educatinal planning, the multiple purposes of corporations, governments, and universities suggest that different methods of planning must be chosen and developed. The purposes served well by one method of planning would not seem to be equally well served by others, and the multiplicity of organizational purposes strongly suggests a differentiated approach to planning and/or policy formulation. Indeed, the differences among corporate, regional/urban, and collegial planning models in the U.S.A. impress some observers as being both extensive and profound.

Corporate planning models must take into consideration the production and distribution of goods and services for profit. Planning efforts are often tightly directed by executive teams making varied use of planning specialists and expert consultants. Without exception, the nature of the planning is oriented to results and the outcomes of planning may be a relatively easy re-organization of corporate structure, with comparatively easy re-allocation of corporate resources. A data base is often available in the form of economic and demographic trends graciously supplied by a benevolent federal government. Marketing surveys are readily obtained from competent, private sources. The improvement of living standards and increases in customer satisfaction are among the benefits of corporate planning but they are more likely to be side-effects or eventual pay-offs than direct benefits. Corporate planning is accountable only to stockholders, one or more federal regulatory agencies, and an occasional consumer advocacy group. And if successful, corporate planning may bring bonuses, promotions, and high levels of responsibility to its participants.

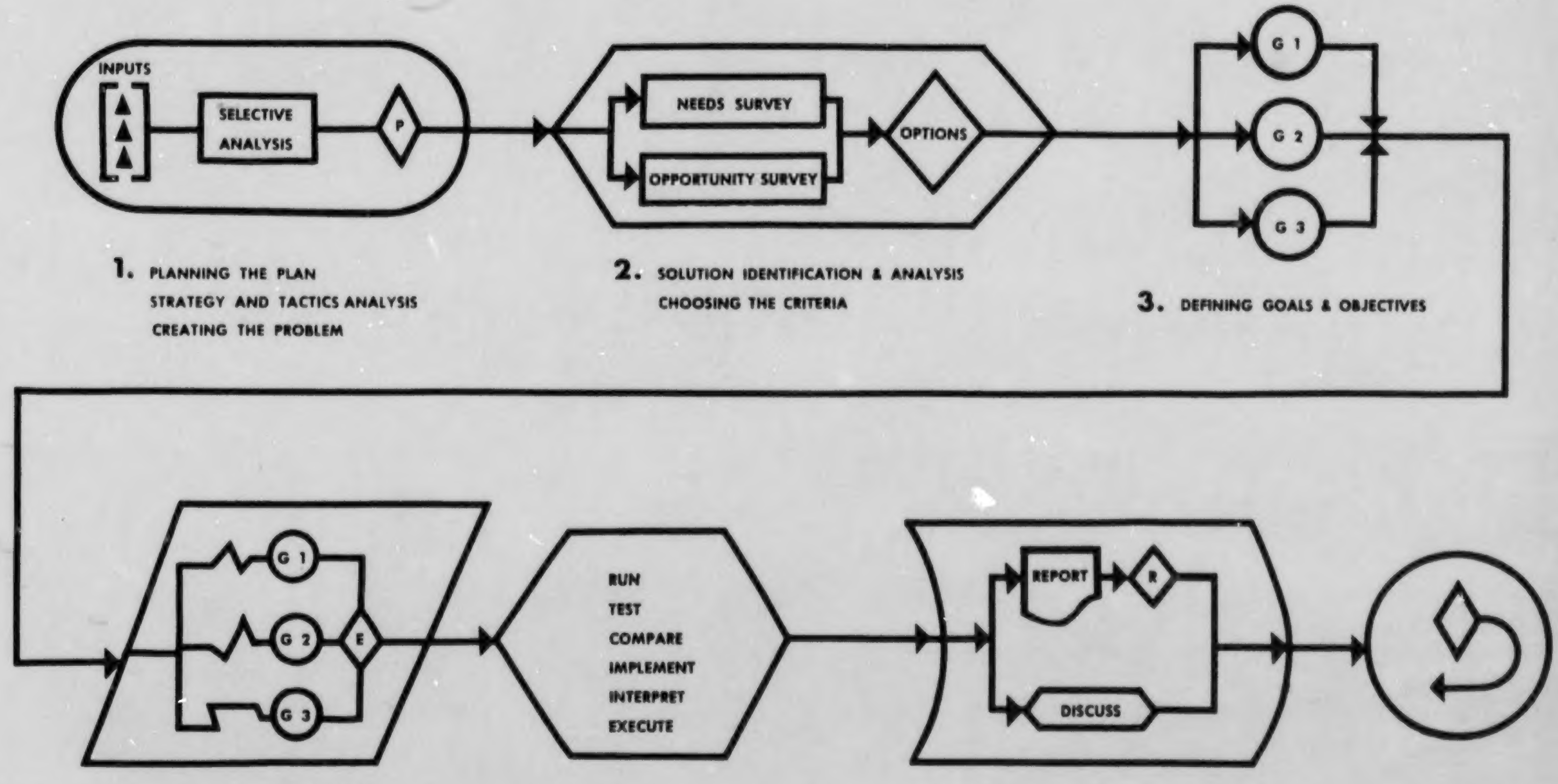
Regional/urban planning has a different objective in its concern with land use and the spatial/temporal environment in which people live. Professional planners and/or consultants may contribute substantially to the deliberations of public planning commissions, but planning outcomes in the form of public policy, guidelines, and regulations may produce bitter public confrontations. The public, for whom planning is done, may decide that it has other property rights and privileges that are more important than those envisioned by planners. The data base for planning may be extensive, in the form of historical records and demographic shifts, but commission-directed surveys of land use and public opinion may alter the phenomenon they objectively study. Quality of life and improved patterns of community living are obvious benefits to be gained from regional/urban planning, but they may be too indirect to gain acceptance by the citizens, taxpayers, and voters to whom the planning is accountable. And for those participating in the process, professional and/or personal satisfaction may be the only reward.

Similarities with corporate planning and regional/urban planning are readily detected, but their differences with college and university planning are much more pronounced. Collegial planning addresses societal needs for institutions, programs, and other services in postsecondary education. Responsibility for such planning is often assigned planning committees that may include public representation, but more often a planning team or group will consist of institutional representatives who are chosen for their internal constituencies. Planning may be accountable to governing boards, federal or state agencies, or the academic community at large, but the outcomes of planning will most likely be changes in institutional policies, additional accredited programs, improvements in financing and funding, and a restoration of institutional vitality or public image. The data base for collegial planning may vary greatly. In many cases, more data on enrollment trends, faculty supply and demand, and institutional income/expenditures will be collected than will be used. And unless the planning is exceptional, there will be noticeable leaps from the data base to the envisioned future programs and services of the institution. The advantages and benefits of collegial planning will be particularly difficult to communicate to clients, users, and beneficiaries of the institution. Often these will be expressed in terms of improved student competencies and faculty performance, better incentives and rewards for teaching and learning, and enhanced institutional image or reputation, but the indices will lack the tangibilities that usually come with corporate planning. As for the benefits to planning participants, there may be occasional promotions or re-assignment of duties but there will be no bonuses and very little public recognition. Many participants in collegial planning prefer, in retrospect, not to be identified with the outcomes or results of their planning efforts.

The gist of the differences among corporate, public, and collegial planning would seem to be the logical, sequential, problem solving approach that is permissible in corporate planning and the political, deliberative involvement and participation that characterizes regional/urban planning. Success in the former is apparently dependent upon the systematic, step-by-

FIGURE 1

A SYNOPTIC MODEL FOR GENERAL PROBLEM SOLVING


INPUTS
SELECTIVE ANALYSIS
P
NEEDS SURVEY
OPPORTUNITY SURVEY
OPTIONS
G 1
G 2
G 3
G 1
G 2
G 3
E
RUN
TEST
COMPARE
IMPLEMENT
INTERPRET
EXECUTE
REPORT
R
DISCUSS

1. PLANNING THE PLAN
STRATEGY AND TACTICS ANALYSIS
CREATING THE PROBLEM

2. SOLUTION IDENTIFICATION & ANALYSIS
CHOOSING THE CRITERIA

3. DEFINING GOALS & OBJECTIVES

4. IDENTIFYING ALTERNATIVES
MEANS-ENDS ANALYSIS
CONSTRUCTING A MODEL

5. TEST AND CHOOSE
TRY & EVALUATE

6. REVIEW & RE-ASSESS

7. RECYCLE
RE-ITERATE
RE-RUN

step, rational, analytic features that are called into play while effectiveness in the latter is related to the commitments and transactions of the planning participants and/or their constituencies. Collegial planning may thus be a hybrid of sequential and transactional planning methods in which there is a varying concern with the rational analysis of data and information -- and the deliberation of concepts and values.

Sequential Versus Transactional Models

An example of a logical, problem solving, sequential model is given in Figure 1. As shown, sequence is the dominant feature of the model and clearly implied is the notion that planners proceed by dealing with, "First, this! Then, that!" As such, the model and the kind of planning that it represents is subject to what Kaplan (1964) has called ordinal fallacies. It is possible to take wrong steps and it is possible to put carts before horses. But if designed and applied well, sequential planning models can enable planners to "loop back" to earlier stages and to refine or to recast earlier decisions and data for later purposes. No step in the process is final and those who prefer to see iteration as the dominant feature have reason for doing so.

Transactional models, such as the one shown in Figure 2, have the advantage of permitting the interplay of attitudes, beliefs, and values in the planning process. Value premises and/or preferences can be handled in a process of proposal, counterproposal, and compromise. And, of course, the arts of persuasion and conviction are vey much in evidence once the process begins. The prestige, influence, or personal influence of one or more participating policy makers may be crucial in determining planning outcomes. Factual data, its rational analysis and interpretation may be entirely secondary and indeed, may be ignored altogether. The essence of transactional modes of planning may be that they are seldom if ever, research or data based.

Transactional modes, however, have the further advantage of incorporating traditions, norms, standards, and other values that might go unattended in sequential modes of planning. The intellectual and cultural heritage of institutions can influence decisions and choice without reduction to quantified indices, or relegation to a category of uncontrolled variables. Thus, we can better appreciate the natural ambiguity of purpose described by Clark (1983) and the significance of the humanities and arts in the universities of Italy, the specialized schools (grandes écoles) or advanced institutes of France, the maintenance of Oxford and Cambridge as a special class in themselves in England, and the "symbolic unity" brought to many universities by such events as intercollegiate athletics and national championships.

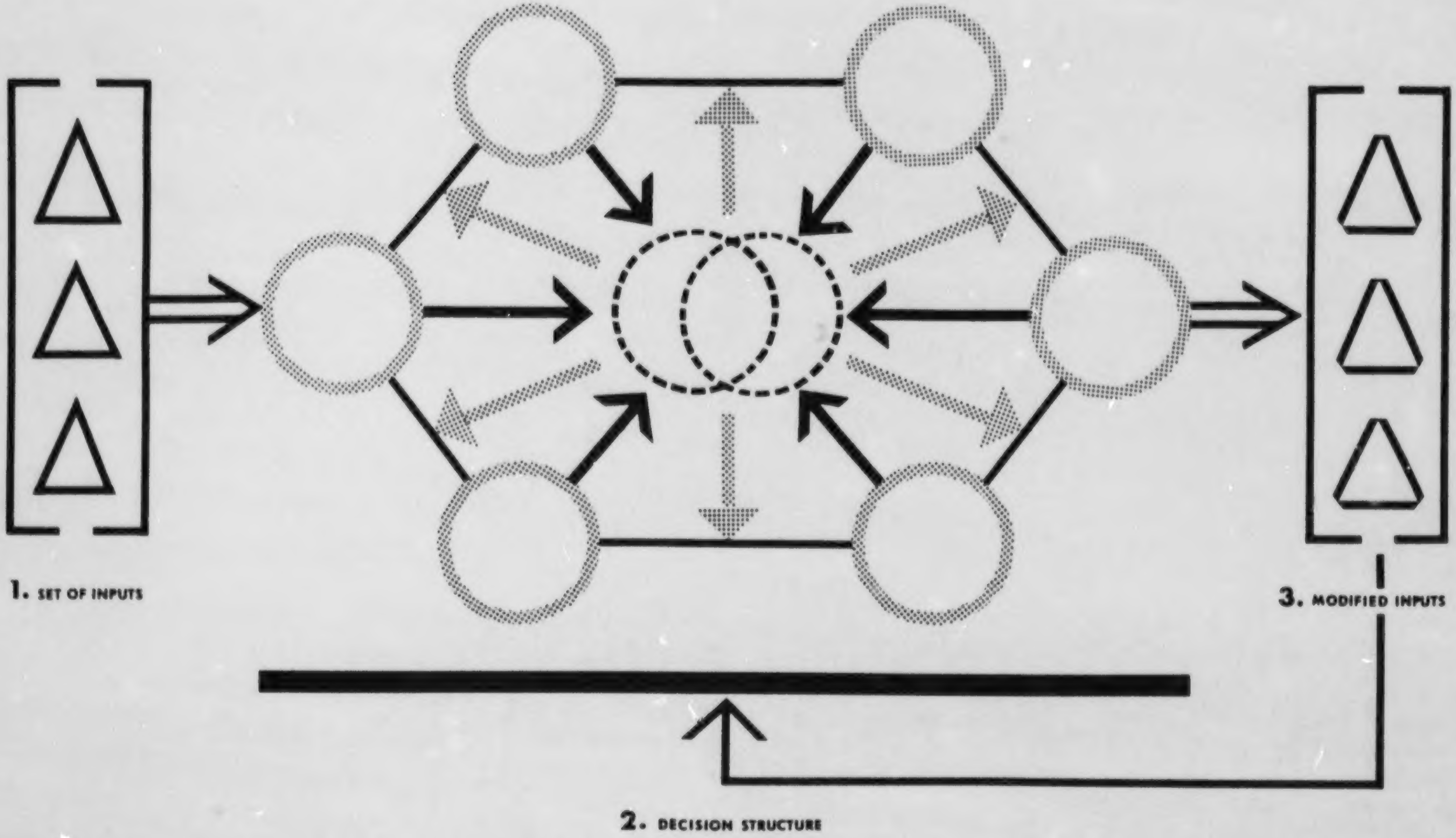
Also accommodated by transactional modes of planning are such values as social justice or equality of educational access, fairness in the application of educational standards, professional or career-related competence, and the development of individual or personal abilities and interests. As policy makers address the recurrent questions of "Who will be educated?" and "What shall they be taught?" they inevitably deal with societal preferences and values. In virtually no planning situations are societal values and preferences systematically derived, empirically established, universally accepted, and easily entered into the quantitative formulas of computer-based planning models.

The Coalescence of Planning Models

If planning is correctly perceived as the formulation of institutional and program policy and if the choice of planning methods is dependent

FIGURE 2

A HEURISTIC MODEL FOR POLITICAL DECISION MAKING


1. SET OF INPUTS
3. MODIFIED INPUTS
2. DECISION STRUCTURE

upon institutional purposes, there is appreciable need to reconcile the effective-but-conflicting components of planning methods and/or models. Viewing a professional lifetime of involvement in policy-oriented research, Husen (1984) dismisses linear, problem-solving models of research and planning on the grounds that they do not depict the realities of educational policy making. The direct chain of basic research to applied research to development and application simply cannot be observed. Husen is supported by Premfors (1984) who writes that he has observed no major instances in which research made a difference in policy change. He believes that the extensive changes in Swedish higher education since World War II would have occurred with or without the research undertaken.

If changes in Swedish higher education have been better planned or more socially-engineered than in other nations, the relevance of rational, analytic methods of planning is indeed suspect. Yet, as Husen, Premfors, and others recognize, there are ways in which systematic, objective planning contributes to educational improvements and progress. Such efforts often serve well to enlighten or sensitize policy makers to crucial policy issues and the results of sequential, problem-solving planning can be used effectively within the framework of political/deliberative decisions and choices concerning educational policy.

In planning practice the conflict between sequential and transactional models may not be as severe as they are in theory. In the U.S.A. there has long been a tendency in a national character to seek practical compromises that avoid either/or deadlocks. No planning commission, committee, or team will fail to collect and at least peruse massive data on the educational enterprise with which they are dealing. And from within the membership of planning groups will inevitably arise spokesmen for particular ideological views, societal preferences, or value premises. And before reporting their findings and making their recommendations, all planning groups will agree, tacitly or otherwise, on some rationale that bows in the direction of objective facts and educational realities. If the reasons for a finding or a recommendation are blatantly political, they will never appear as such in published form; reasons, findings, and recommendations will always be rationalized in terms of societal and educational necessities.

The experiences of many planners would suggest that it is indeed possible to coalesce the effective features of diverse planning methods and some degree of coalescence may be inevitable in the planning process. If the choice, development, and use of planning methods remain sensitive to the multiple purposes of complex, large-scale institutions, no planning process will be the mechanistic application of pre-determined planning models. Provisional variations will be made in the planning process as their necessity or desirability become evident to the planning participants. Whatever planning is, it is not a replication of classical experimental designs.

Quality and Efficiency as Planning Objectives

Among the changing demands placed upon institutions of higher education in the past decade, none have been more crucial than public demands for improved quality and increased efficiency. A global crisis in energy was particularly effective in calling attention to limited natural resources and national needs for better means of resource allocation and utilization. National goals for improved access to postsecondary opportunities were soon followed by national needs to ensure that quality was not being sacrificed in the process.

To serve well as planning objectives, however, both efficiency and quality must be more carefully defined, and more adequate means of measuring or assessing each must be developed. As easily as efficiency and quality enter the thought and discussion of university administrators and faculty, both concepts are in need of working definitions that will serve the purposes of educational planning, assessment, and evaluation. In brief, there are no measures of efficiency and quality waiting to be discovered; indices of both must be empirically developed and validated (Fincher, 1978).

Both concepts are employed too easily as absolutes in a world that is always relative. Efficiency is often discussed as if it were the opposite of effectiveness and quality is treated in similar manner as if it were the opposite of quantity. Neither efficiency nor quality would seem to be absolute as usage implies, and appreciable harm will result from thinking of efficiency and effectiveness, quality and quantity, as mutually exclusive categories.

In both engineering and economic terms, efficiency can be computed as a ratio of outputs and inputs. The computation of indices of efficiency thus becomes a matter of specifying the inputs to a process and then deriving useful measures of relevant outputs. In applying such ratios to higher education, however, numerous mistakes are made concerning the composition of both outputs and inputs. Too frequently, educational costs are considered as the only inputs because they presumably are easy to estimate and attention can then be directed to measures of effectiveness, benefits, utilities, and advantages that can serve as educational outputs. When cost/effectiveness ratios are treated as indices of efficiency, it is evident that efficiency and effectiveness are neither absolute nor opposing concepts.

The efficiency of higher education has been severely criticized because simplistic notions of educational costs have encouraged simplistic notions of educational outputs. The return-on-investment for a college education, for example, has often been computed on the assumption that initial salaries, pay-raises, lifetime earnings, and other evidence of pecuniary gain are the only reasons for attending college. The differential between the initial salaries of college and secondary school graduates has been used in arguments that a college education is not worth what it costs. Granting the premises upon which such arguments are made, the rate-of-return for some occupations does indeed suggest a poor investment of private funds. Such arguments are notoriously weak, however, in handling societal benefits and costs that are involved, personal benefits and/or utilities that may result from college attendance, and personal/societal advantages that are often ignored.

Serviceable indices of quality are not so easy to compute. Quality is usually presented as an attribute or characteristic that is not amenable to scaling and/or measurement, and no one seems to have computed cost/quality ratios to capture the attention of critics and observers. Rejected in such notions of quality is an older point-of-view in which qualities are seen as distinctive attributes, properties, or scalar dimensions that exist in some degree, amount, extent, or magnitude (Kaplan, 1964).

As used in many educational discussions, quality is the 1980 version of excellence, as interpreted in the 1960s by John Gardner. But whereas most of us can agree that Gardner gave an excellent interpretation of excellence, no one has yet issued a quality statement on quality. It is altogether possible that no such statement will be issued because of doubts that quality is a characteristic that can be attributed to institutions of higher education in their entirety. Because of the complexity of universities and the remarkable variation seen in their programs and services, quality is an institutional characteristic only by reputation and ascribed status. Quality is sometimes an inferred feature because of selectivity in admissions and the resulting prestige. But in such terms, quality is linked too strongly to elitism in education and when value-added notions of evaluation are applied to many such institutions, they do not show the increments in student achievement and competence that larger, less selective institutions do. Still, there is some basis for choosing selectivity as one indication of quality; research has almost always shown the individual differences of students to be the largest, single determinant of educational outcomes, and institutions that admit only talented and accomplished students will turn out talented and accomplished graduates.

Just as quality might not be attributed to institutions, so is it unlikely to be a dominant characteristic of baccalaureate degree programs, when considered as a whole. The Carnegie Foundation (1977) has identified major fields of study in American universities as "a success story" but believes general education to be "an idea in distress". Their evaluation suggests that American college and university faculty members teach well the subjects in which they have specialized and teach poorly courses that are general or indirectly related to teaching and research interests of the faculty.

The improvement of quality would thus appear to be dependent upon agreement on what needs to be improved. Such an agreement must begin with recognition that qualities are plural and not Platonic ideals or forms. Aristotelian notions of quality would suggest that in most academic programs and services, there might be an integrity, coherence, unity, or wholeness without which education is incomplete or fragmented. In this way, quality could be regarded as an intrinsic feature that we derive or infer from empirical evidence, informed judgments by knowledgeable professionals, or combinations thereof. Peer review has been, and continues to be, an effective way of evaluating research proposals and the potentiality of research projects; it is not an unknown way of judging quality and the improvement of quality.

A pragmatic criterion for quality might be that it is a distinctive characteristic about which there is no doubt. The outcomes, appropriateness, and/or effectiveness of some programs, methods, services in higher education are such that no one seriously doubts their quality. In such cases, there would appear to be "a goodness of fit" between program purposes and program performance that is publicly expected and publicly verified. Another way of saying this is to point to the consensual validation that some educational programs, methods, and services have attained. Their outcomes are not believed by knowledgeable and reasonable observers to be unintended, unanticipated, and/or fortuitous. The value premises of such programs, methods, and services can be articulated and we can attribute to them a quality or merit deserving of public and/or societal support and esteem.

Conclusions and Implications

The difficulties of planning for quality and efficiency in higher education are not insurmountable, but there are difficulties. Many of these difficulties are the result of conflicting demands placed upon institutions of higher education in democratic societies. The purposes of higher education are multiple and complex; and so the purposes of planning must be. In turn, the choice and development of planning methods is dependent upon our many reasons for planning. There is no one method, technique, or system of planning that is best for all institutions of higher education. Where a particular method, technique, or system has served an institution well, it is probably one that the institution has designed, developed, and/or adapted for its particular uses and purposes.

A value premise upon which this paper has been written is the belief that educational planning should be for educational purposes. The university is not a business corporation and it is not a government agency. There is an interdependence, nonetheless, among universities, corporations, and governments that must be acknowledged and cooperation, instead of competitiveness, should be one purpose in planning. Quality and efficiency are other policies or planning purposes that universities, corporations, and governments alike should pursue.

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PROGRAM QUALITY:
DEFINITION, ASSESSMENT, ENHANCEMENT

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> Quality...you know what it is, yet you don't know what it is. But that's self-contradictory. But some things are better than others, that is, they have more quality. But when you try to say what the quality is, apart from the things that have it, it all goes poof! There's nothing to talk about. But if you can't say what Quality is, how do you know what it is, or how do you know that it even exists? If no one knows what it is, then for all practical purposes it doesn't exist at all. But for all practical purposes it really does exist. Where else are the grades based on? Why else would people pay fortunes for some things and throw others in the trash pile? Obviously some things are better than others.. but what's the 'betterness'?... So round and round you go, spinning mental wheels and nowhere finding a place to get traction. What the hell is Quality? What is it?
>
> Robert M. Pirsig, Zen and the Art of Motorcycle Maintenance (1974)

Introduction

In the seventies it became clear that universities in the United States as well as in Western Europe could no longer escape the demands for openness and accountability that were imposed upon all large and powerful institutions. This had led to the conviction that academic planning must include the review of existing programs for the dual purpose of developing quality programs and the termination of ineffective and unproductive programs.

In the past years many institutions, such as the University of Montreal, were led to the conclusion that the quality of academic programs "could no longer be safeguarded by continuing to make across-the-board compressions" (Bélanger & Tremblay, 1983, p.1). In this context a great deal has been said about performance assessment of an institution in terms of its responsiveness to the changing needs of society and the consequences of this assessment in terms of the elimination of certain programs. The term "educational program" in this paper is used in the sense of a series of courses leading to a degree or certification. This of course does not alter the fact that the universities are responsible for properly carrying out those courses which they have selected to offer.

During the past years Dutch universities have been overwhelmed by problems related directly to the quality of educational programs:

1. Retrenchment resulted in a serious reduction of the staff/student-ratios in the budgeting model of the Ministry of Education, for some disciplines amounting to 40%.

2. In a nationwide process of concentration of academic programs a num-

ber of specific fields of study were concentrated in one or a few universities. This concerned mainly specialized programs with small enrollment, but also Dentistry and Pharmacy.

3. After 12 years of discussion and university opposition a law was passed in Parliament which forced the universities to restructure their curricula from the existing five to six years into four-year curriculum.

4. The new budgeting procedures of the Ministry of Education account for the quality of research programs: research funds are allocated to universities on the basis of submitted research programs of acclaimed and externally reviewed quality in five-year cycles. What this implies for the planning process of a university has been described by Dijkman & Savenije (1983); the emphasis on research constitutes a threat to the quality of educational programs.

Thus educational programs became fewer in number, cheaper, and shorter, while the academic staff is inclined to pay more attention to research than to their teaching activities.

In some recent Dutch publications fear has been expressed that these measures are threatening the quality of educational programs to such an extent that, even when retrenchment has come to an end, the quality of the remaining programs may be seriously questioned. (See for instance Holleman, 1983 and Veldhuis, 1983.) As a consequence, universities are urged more than ever to safeguard the quality of their educational programs and to prove that their programs have and will retain the quality required.

In the following sections of this paper, some possibilities will be discussed for the definition, assessment, and enhancement of program quality. As a result of this analysis, the ways in which an institution can deal with its responsibility in this situation will be indicated.

Defining Program Quality: Some General Considerations

In discussions about program quality a variety of points of view can be observed. While some maintain that the concept of quality is unanalysable and that it is impossible to give a definition of program quality, others try to show that this concept is perfectly analysable and that program quality can even be quantified. (The first position for instance was taken by David Hold in a panel session at the 23rd Forum of the AIR at Toronto in May 1983, the latter by Straumanis, 1981.) Most of the participants in such a discussion take a position in between the two extremes without much care for general agreement on a definition. Do we need a definition of program quality? Why do people need definitions at all? It might be useful to give some general considerations about the use of definitions. (See Copi, 1968 and Kahane, 1969.) Copi (1968) distinguishes five kinds of definition (pp. 97-103):

(a) stipulative definitions (to introduce a brand-new term);

(b) lexical definitions (to eliminate ambiguity, while the term being defined is not new);

(c) precising definitions (to clarify the meaning of an existing term which has an established although vague usage);

(d) theoretical definitions (to give a theoretical explanation);

(e) persuasive definitions (to influence other people's attitudes).

People make use of definitions for several purposes, for instance to increase their vocabulary by the introduction of a new term, or to eliminate ambiguity. When we need a definition of program quality, this is because we want "to clarify the meaning of an existing term with an established, although vague, usage". Talking about the meaning of a term, we have to distinguish between extensional meaning (the class of objects to which the term can be applied) and intensional meaning (the properties possessed by all the objects in the term's extension). To clarify the vagueness of the usage of the term "program quality", we have to clarify its intensional meaning. There are three techniques to do this:

1. A synonymous definition defines a term by giving another term with the same meaning.

2. An analytical definition (definition per genus et differentia) divides the objects to which the term can be applied into classes of objects with some property in common, and then divides these classes into subclasses in which all members have some further property in common which is not shared by any other subclass (so for example, the term "triangle" means a polygon having three sides).

3. A contextual definition defines a term by referring to the context in which it occurs.

Let us see which one of these techniques is best suited for our purpose. There is no suggestion that I know of that the first kind of definition is of use to us. The second one is of a classical kind. Classical logic used to define properties by taking opposites of any type as mutually exclusive and exhaustive alternatives. In our case this would mean that all educational programs were to be divided in two classes: good programs and bad programs. This means that the analytical kind of definition is also useless to us because program quality is unmistakably a relative concept. Perhaps this is best illustrated by the following example: if A, B and C are three programs, A being better than B and B better than C, then A is clearly better than C. Classical logical theory was not able to deal with relative concepts. Thanks to the logical theory of relations we are able to deal with them even if they can not be quantified. In the words of the philosopher Rudolf Carnap (1951): "Sometimes scientists, especially in the field of social science and psychology, hold the view that, in cases where no way is discovered for the introduction of a quantitative concept, nothing remains but to use concepts of the simplest kind, that is classificatory ones. Here, however, they overlook the possibility and usefulness of comparative concepts, which in a sense, stand between the other two kinds. Comparative concepts serve for the formulation of the results of a comparison in the form of a more-less statement without the use of numerical values". This means that the quality of a program has to be defined in relation to the quality of another program or the quality of the program itself at another moment. (See also DeGroot, 1983.)

In this context the third kind of definition mentioned above can be of use. It enables us to define program quality in the following way: "Program A is better than program B if and only if ...." (followed by a statement about the programs A and B) or "Program A at moment x is better than at moment y if and only if ...." (followed by a statement about program A at moment x and at moment y).

Assessment of Program Quality

According to the analysis above the best way to express judgements about program quality is as a comparison between different programs. For such a comparison we need, of course, criteria of quality. In the literature about program review and quality assessment we can find a variety of these criteria. Table 1 gives an enumeration of such criteria, derived from a number of authors. (Barak and Berdahl, 1978; Gapen and Morse, 1983; Holleman, 1983; Marcus, Leone, and Goldberg, 1983; Melchiori, 1980; Seagren and Bean, 1981; Semrow, 1977.) The list is not exhaustive and, more importantly consists only of examples of criteria which were of use in a specific case or in an analysis from a specific point of view. This does not necessarily mean that they are applicable in all other cases.

Table 1

Examples of criteria for quality assessment

	Output-oriented	Process-oriented
quantitative	number of graduates admission to degree programs results of licensing examinations scholarship recipients credit hour production grade point average student enrollment	faculty work load class size cost per program graduate student workload retention rate attrition rate optional courses offered
qualitative	employment found by graduates professional production of graduates student outcomes student achievement vocational relevance general student interest	support services - advising and counseling system - libraries/laboratories/equipment faculty performance - teaching experience - qualifications - opennness to students social climate student evaluations learning improvement program space utilization

Criteria for the assessment of quality can be divided into a number of categories. First, we can distinguish quantitative and qualitative criteria. Secondly, a distinction can be made between output-oriented and process-oriented criteria. The enumeration in Table 1 illustrates these distinctions.

Judging program quality is making statements about the degree in which programs succeed in causing the effects desired. When we look at the criteria from this point of view we can notice that some of them can be considered as desired effects (or manifestations of quality), without an indication of how to judge the degree of success (for example social climate, general student interest, national reputation). In order to judge the degree in which desired effects are actually realized, we need empirical observations which tell us something about the occurrence of the effects desired. We will call the results of those empirical observations indicators of quality. While the manifestations of quality follow logically from the purpose of an educational program, indicators are to be discovered by empirical research. For example, research is needed in order to know whether a staff/student-ratio is an indicator for student achievement. Several criteria in the list of Table 1 can be seen as indicators of quality. A good example is the type of employment found by graduates.

Indicators of quality need not necessarily be quantitative. They must, however, enable us to make a comparison between different programs. For instance when the indicator is based on student evaluation (data to be obtained by questionnaire or by individual interview), the result will not always be quantitative but can nevertheless enable us to compare different programs.

Generally, judgements about program quality are made on the basis of an evaluation. Depending on the context in which such a judgement is needed, it may well be the case that only some of the possible indicators are relevant. The determination and selection of indicators is an important part of the evaluation process. According to Dressel (1976) an evaluation should:

(a) seek a historical and philosophical validation of program goals;

(b) determine the alignment between the program rationale and desired outcomes;

(c) examine quality indicators;

(c) determine whether the societal consciousness of students has been increased and internalized.

Let us now return to the problem formualted in the introduction: how can universities fulfill their responsibility for the quality of their educational programs? Is it possible to prove that programs are (or are not) of sufficient quality? Our analysis implies that such a proof has to be given in terms of comparison.

The simplest way seems to be a comparison with a certain standard. Some authors (for instance Straumanis, 1981), claim that it is possible to produce an overall index of quality for a particular educational program on the basis of aggregated scores of different indicators. A particular index could then be defined as a standard for quality. Such a standard would enable us, even while we recognize the relativity of the concept of quality, to divide all programs into two classes: those above the standard and those below the standard. In my opinion the definition of an overall index of quality is not possible. It presupposes that we can give each indicator a relative weight in comparison to the others. But the relative weight of each indicator depends on the purpose of the evaluation process and thus varies from occasion to occasion. Furthermore, different indicators have different relations to the manifestations of quality: some are linear, some are not. Last but not least, as we have seen, not all indicators are of quantitative nature. In the words of DiBiasio, Girves, and Poland (1981): "Quality is not an absolute and cannot be expressed in absolute terms. There is no ruler to measure quality in graduate education. Therefore, it is important that institutions establish many devices for determining how well their programs perform".

A second possibility would be to define a standard for each of the various indicators and to state that the quality of a program is sufficient when the score on each indicator is at least equal to the standard for that indicator. However, it would be very difficult, if not impossible, to agree on a standard for each indicator. Take for example an indicator concerning the quantity of the output, for instance the number of graduates. For a definition of standards we would have to ignore the differences betwen programs or universities.

Can universities demonstrate the quality of a progam by means of comparison with other programs? Within one university such a comparison does not seem to be very helpful in the situation we are confronted with: the doubt about the quality is not restricted to one single program and a comparison could lead people to the conclusion that all programs are just as bad.

For a comparison with the same kind of program at other universities we have to take into account the difference in circumstances (for instance: unequivalence of certificates, differences in cultural background of institutions, unemployment rate in certain regions). Such a comparison will therefore only be possible if we can restrict ourselves to a number of selected indicators, which of course reduces its value. Besides, such a comparison does not help at all if doubt about quality is not limited to one institution but concerns the higher education system in a whole nation. It goes without saying that comparisons with foreign universities are even more difficult because the differences in circumstances will probably affect a large number of indicators.

The conclusion is that it is pointless to define a standard for the quality of educational programs and that it is very hazardous to make an overall comparison of quality between two different programs. It follows that universities cannot be asked to provide a proof of sufficient quality of their educational programs.

The Enhancement of Program Quality

As has been shown, overall comparisons between separate programs are difficult, because different circumstances make the various indicators less comparable. Nevertheless, comparisons restricted to a limited number of indicators can be useful, but not to compare "overall program quality". The problems related to comparisons are much smaller or perhaps even negligible when we compare a program with the program itself at another moment of time in order to judge the enhancement of program quality.

Analysing the enhancement of program quality we have to keep in mind Wildavsky's law: "Movement on one indicator can be maximized provided society is willing to ignore all other indicators" (1979).

In the context of quality assessment directed towards enhancement, we are now able to give a rather simple definition of the concept of program quality, which is not perfect but nevertheless can be of use in the planning process of an institution. It is a contextual definition which emphasizes the relativity of the concept of quality, and is based upon the use of indicators. It presupposes that programs can be compared with one another with regard to each of a set of indicators, but it does not necessarily entail that all indicators have to be purely quantitative.

The quality of a program is enhanced when at least one of the indicators shows improvement, while none of the others shows deterioration.

So, although it is not possible for institutions to prove that their programs are of sufficient quality, they are able to direct their planning procedures and allocation models towards the enhancement of quality.

My conclusion is that the keyword for an institution's concern for the quality of educational programs must be "enhancement". Responsibility for program quality can then be fulfilled by a constant concern for quality enhancement.

Planning Procedures and Allocation Models

To determine the measures that lead to quality enhancement an evaluation process is needed, involving among other things the determination of the indicators that are relevant in the case at hand.

According to Dutch law, the councils of the individual departments are primarily responsible for the educational programs, not the university management. The evaluation of the programs therefore has to be initiated and to be carried out by the departments to make sure that it will actually lead to the implementation of measures directed towards quality enhancement. (For a discussion of the importance of the involvement of the participants and decision makers in an evaluation process, see Cochran and Hengstler, 1984.) University management is responsible for decisions about the beginning and termination of educational programs and the stimulation of quality enhancement through the structure of the planning process and the allocation model.

As we have seen it is not possible to give an exhaustive list of manifestations and indicators of quality applicable to all programs in all circumstances. But we can divide the possible indicators of quality into a number of categories according to whether they are output-oriented or process-oriented, and whether they are directed towards qualitative or quantitative aspects.

According to this distinction, program quality, from the point of view of university management, can be enhanced by stimulating:

1. improvement of the program output;
2. increase of the program output;
3. improvement of the process of the program;
4. reduction of the cost of a program.

Once again we have to keep in mind Wildavsky's law: improvement on one point should not involve negative consequences for the others.

At first glance, the simplest way to stimulate quality enhancement seems to be to give more money to programs that are improving and less money to those with diminishing quality. This, however, appears to be a self-fulfilling prophecy: programs with a diminishing quality will get worse and worse.

A research program with diminishing quality can be stopped, but once an institution has decided it has to offer a certain educational program (for reasons like student interest, national uniqueness, etc.), it has to see to it that the program is carried out properly. If the quality of such a program is diminishing, measures have to be taken and cutting the budget surely cannot be one of them.

Let us now take a closer look at each of the categories of indicators.

Output Oriented

To improve the output of a program we need an evaluation of the use students make of their education. Two factors are relevant here: the needs of society and of students (including prospective students). In order to meet different and changing needs the programs must have a flexible structure that makes different courses interchangeable. Students are to be given good guidance as to how they can construct a program out of the courses offered and the expected *effectus civilis* of the different programs. Since not every student will take all his courses within one department the allocation model has to account for the teaching load concerning students from other departments. Therefore, a calculation of the teaching load based merely on the number of graduates will not be an incentive for departments to make their courses attractive for other than their own students.

Bogue (1980) suggests that the output can be improved by setting aside a certain part of the budget to be divided according to the success of the students after their graduation (employment, licensing, examinations, etc.). This presupposes, however, that the success of the students graduated in different programs can be compared, which will not always be easy (take for instance Liberal Arts and Dentistry). Furthermore, though a program may rightly be called better than another when it is more adjusted to the needs of society, the fact that a number of students knowingly prefers a different set of courses because of their personal needs does not make the program any worse.

The quantity of the output will be also influenced by a flexible structure of the programs. The more freedom students have to select their courses within a particular program, the more students will graduate. A second possibility to increase the output is to increase enrollment. Therefore, it is necessary to investigate which factors make students enroll in a specific university. Unlike in the United States, this kind of research takes place only incidentally in Western Europe.

Thirdly, the allocation model can give a stimulus for the production of more output when it is based on output measurement. Allocation on the basis of enrollment, however, does not stimulate the increase of output. It is also not sufficient to take into account only the students that have graduated. Some students deliberately take only a limited number of courses, some fail to finish the program, but nevertheless profit by the part they did finish. But there is still another objection against the restriction of output to the number of students graduated: in order to predict the output and also to account for major changes in enrollment it is necessary to determine the graduation rate. (A graduation rate is the percentage of a cohort of entering freshmen which receives a degree at some time.) Such a calculation can only be made after a number of years and the value of the prediction can be seriously questioned when the circumstances change as fast as they have done these past years. An example of a more flexible system is a budgeting model based on the number of credit-points earned by students in the previous year, a system under consideratin at the Unviersity of Utrecht.

Process Oriented

For the improvement of the process of a program a regular evaluation of the process is necessary, to be carried out by the department concerned. Evaluation is stimulated if certain input data of the allocation model are recognisable and interesting from the point of view of evaluation, attract attention, and evoke questions. For this purpose the output of an entire program (the number of graduates) is less appropriate than the output of a smaller entity. Measurement of the output of small sets of courses, or single courses, can indicate differences in parts of a program that involve the same staff. This kind of output data also rouses students' attention and they too can give a stimulus for an evaluation.

Secondly, the allocation model can stimulate the presence of desirable facilities (student guidance, certain committees, etc.) by means of a penalty reduction when these facilities are absent. It must be noticed, however, that penalty reductions of the budget are more or less out of place when the planning process of an institution is directed towards an agreement between departments and university management. Another possibility is to reserve a limited budget for clearly defined projects directed towards the improvement of one or more aspects of certain programs.

Finally, in order to stimulate departments to investigate how the costs of a program can be lowered without loss of quality, it is necessary that the budget be given to the departments as a lump sum in order to enable them to find a more effective destination for the money that is saved.

Summing up, there are a number of measures, concerning several aspects of program quality, that the management of an institution can take in order to stimulate enhancement of the quality of educational programs:

1. Stimulate evaluation, which means an important role in the planning process for program review.

2. Stimulate increased flexibility of the programs.

3. Base the allocation model on output data of (relatively small sets of) courses.

In conclusion I would like to make some remarks about the alleged advantages of the use of graduation rates in allocation models. Several Dutch universities calculate the budget for educational programs on the basis of predicted enrollment and calculated graduation rates.

One of the reasons for this preference for graduation rate probably is that one is inclined to think that graduation rates give an overall judgement of quality. But in order to be useful for planning purposes, a graduation rate has to meet certain requirements (account for students that successfully change programs and students who enroll but do not actually take part in the program) at the cost of its usefulness as an indicator for program quality.

In discussion about allocation models it is sometimes argued that a model on the basis of the output of a smaller set of courses or even single courses will have negative consequences for program quality: it is feared that departments will be inclined to lower the requirements for their courses and that students soon will discover which courses are the easiest and will prefer these.

I doubt whether this fear is real. Every system that stimulates the production of output carries in itself a certain danger for the quality of the output. But the smaller the set of courses of which the output is considered, the sooner the data will be available, the easier it is to find other courses to compare with and the easier it is to notice the occurrence of undesired effects. In other words a model based on the output of single courses has certain dangers, but also produces the data to signal whether the undesired effects actually occur. A model based on graduation rates has more or less the same dangers: departments profit from good results of the students and students looking for the easiest courses will find them anyway. But a model based on graduation rates does not itself produce the data to control such effects.

Summary and Conclusion

According to the budgeting procedures in Dutch universities, research funds are allocated on the basis of submitted research programs of externally reviewed quality in five-year cycles. Because of a number of reasons it is much more difficult to account for the quality of educational programs. Firstly, research programs can be stopped when one is not satisfied with the quality of the program, but this is not always possible with educational programs. Secondly, in comparison with educational programs there is a more direct relation in research programs between the quality of the faculty involved and the output of the program. Thirdly, the goals of a research program are generally less complex than those of an educational program and the output is easier to observe.

On the other hand, because educational programs are carried out repeatedly, it is possible to judge the changes in program quality. It is argued that the general concern of an institution for the quality of educational programs cannot be the distinction between good and bad programs, but must be a constant effort to enhance the quality that is already present.

NOTE

The views expressed in this paper are those of the author and do not represent either the organization or the authorities involved.

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THE USE OF BIBLIOMETRIC DATA AS TOOLS FOR UNIVERSITY RESEARCH POLICY

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Introduction

The central issue of this study is the examination of the potential of quantitative, literature-based (i.e. bibliometric) indicators as tools for university research policy. As a subject of extensive investigation we analysed the research performance of two large Faculties of the State University of Leiden (Faculty of Medicine and the Faculty of Mathematics and Natural Sciences) for the period 1970-1980. In contrast to other recent studies in this field (e.g. Martin and Irvine, 1983) we focussed on the (university) research group as the unit of analysis.

The study presented in this paper (a very detailed discussion is given by Moed, Burger, Frankfort and van Raan, 1983) was a response to the necessity for a large-scale project evaluation which resulted from a drastic change of the allocation system at the State University of Leiden. The academic staff allocation system for teaching and research at Leiden was originally based almost entirely on student numbers. In fact, in the old allocation system there was a fifty-fifty ratio between staff time spent in teaching and research, as is usual in Netherlands academia. This system, however, became increasingly unsuitable for financing research units on the basis of scientific merit. Furthermore, staff allocation for research should be protected against the financial consequences of the decline of student numbers. As a result of these considerations, the allocation system at Leiden was changed radically a few years ago (van Raan and Frankfort, 1980) into a research project grant system. The establishment of a separate university research 'financing channel' was achieved technically by a very considerable reduction of a proportionality factor which in the earlier allocation system coupled the research financing (in terms of academic staff) with the teaching capacity based on teaching-load calculations. The resources which thus became available could be 'earned back' with current research projects if the Faculties and departments concerned could demonstrate the quality of these projects. Therefore, university departments were forced to develop research performance criteria and, subsequently, to apply these criteria in a sort of self-evaluation in order to avoid a considerable decrease of research support.

Recently the Netherlands' government changed the national system for university financing into a system very similar to the Leiden system. Both the Leiden system and this recent policy of the national government made the need felt for more objective, quantitative research performance indicators. The project presented in this report (started in 1981) arose directly from this need.

In this paper we are concerned with two important aspects of research performance: output and impact. Output refers to the extent to which the research creates a body of scientific results. Impact is defined as the actual influence of the research output on surrounding research activities.

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A distinction is made between 'quality' and 'impact'. It is assumed that publications must have a certain basic quality in order to generate impact (for a detailed discussion see Moed et al., 1983). However, other factors can determine impact as well -- factors like the state-of-the-art of the scientific field concerned, the visibility of journals, or the extent to which researchers carry out public relations tasks. Impact is a relevant aspect of research performance since from a research policy viewpoint, one should not only require that researchers produce scientific results of some scientific quality, but also that they make their results known to colleagues.

The output indicators used in this study are essentially based on the numbers of publications within the international scientific literature. Impact indicators were constructed on the basis of the number of times these publications were cited during a certain period by other articles published in the international scientific literature. We chose the research group as the level of aggregation since a reseach group usually constitutes the 'natural' unit of research activities (at least in the two Faculties involved).

Publication and citation data were obtained from the Institute for Scientific Information (ISI, Philadelphia). The Science Citation Index (SCI) covers several thousand scientific journals that constitute the core of the international scientific serial literature for many fields within the Natural and Life Sciences. In addition, the SCI contains non-journal material, such as published proceedings, multi-authored books, monographs and thematic collections of papers. Two important indexes are relevant for this investigation. First, the Source Index, which contains bibliographic descriptions of all articles published in the journals or books processed for the SCI. These journals (or books) are called source journals (or books). The articles published in them are called source articles. Secondly, the Citation Index, which lists all the references (i.e. citations) given in the source-articles in a given year.

In this study we considered all publications from the SCI Source-Index which, according to their addressess, originated from the University of Leiden and were published between 1970 and 1980. In addition, we obtained bibliographic data on all source articles published between 1970-1980 which cited any of the Leiden publications. Thus we considered some 6,700 publications and 42,000 citations, the results of about 4,000 academic man-year research activities (12,500 man-year total personnel) and about Hfl 1,000,000,000 (400 million dollars) support from public resources. As far as we know it is the first time that a study of this kind, i.e. a bibliometric research-performance analysis of two university Faculties -- with a large research capacity and a long research tradition over a very wide range of different disciplines within the field of natural and life sciences -- has been undertaken. At this moment we are updating our material for the period 1981-1983, so that eventually we will analyze about 10,000 publications and 70,000 citations. Aside from policy-oriented investigations, we also focused on underlying themes such as publication and citation characteristics in the various fields of science.

Bibliometric indicators -- based on the ISI data -- were calculated for all research groups in the Faculty of Mathematics and Natural Sciences, and in the Faculty of Medicine. An extensive software package (Moed et al., 1983) was developed to carry out numerous tasks with respect to the data handling, which is in fact the combination of two large data clusters (bibliometric data and university data).

In this paper we focus on the main points of our study: the construction of useful types of bibliometric indicators as tools for a univer-

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sity research-policy; the specific problems of collecting and handling bibliometric and university data; the adequacy of the SCI data-base for past performance analyses; disturbance field and time-dependent factors (publication and citation practices) that have little to do with impact as such; and the comments of university researchers on the results of the analyses carried out in this study.

Although this study is focused on a specific Dutch university (noting however that Leiden is generally recognized as one of Europe's major research institutions), the results of our investigation illustrate typical problems arising in the use of bibliometric research performance indicators for university groups.

The Construction of Impact Indicators

We make a distinction between short-term impact and long-term impact. Short-term impact is indicated by counting the citations received by a publication a few years after publication (e.g., during the first three years, or only in the third year of a publication's life-time). Long-term impact considers a much longer period of a publication's life time (some 10 years or more). This study deals with short-term impact. The rationale behind this is that the need was felt to assess the impact of recent work of research groups and to introduce a dynamical aspect (i.e. the trend of short-term impact over a longer period of time) in the assessment of past research performance. In this way, one can indicate groups that might have had considerable research success years ago, producing some high-impact papers, but whose production or impact has since declined. In addition the need was felt to assess groups that have not existed for longer than a few years and consequently do not (yet) have a large past performance. Of course, the influence of a publication cannot be fully determined by analysing its impact over the first few years after publication. One can, however, establish whether or not it is picked up, and whether it plays at least some part in the scientific debate -- although it is hardly possible to assess the nature of the latter. Short-term impact indicators are primarily considered as indicators of the visibility of a group at the research front: the extent to which it is active, its publications are known and picked up by colleague researchers.

We calculated indicators for each publication year during the decade 1970-1980 and analysed trends both in the annual numbers of publications and in the annual numbers of short-term citations received by these publications. An example of this trend analysis (for an arbitrary research group in the Subfaculty of Physics and Astronomy) is given in Figure 1. In this figure, the left panel gives:

Curve 'a' (solid line): number of publications for each year (research-output indicator);

Curve 'b' (dots and dashes): number of citations received by these publications during the first three years of their lifetime, excluding in-house citations [1] (publication-impact indicator);

Curve 'c' (dashed line): the ratio of these two above indicators, or: the number of citations per publications.

The middle panel gives the same indicators as the left panel, but rather than calculating the values per annum, the year-average values for four-year publication blocks are calculated.

The right panel also gives the same type of indicators, but this time for a three-year publication block and a two-year citation counting scheme.

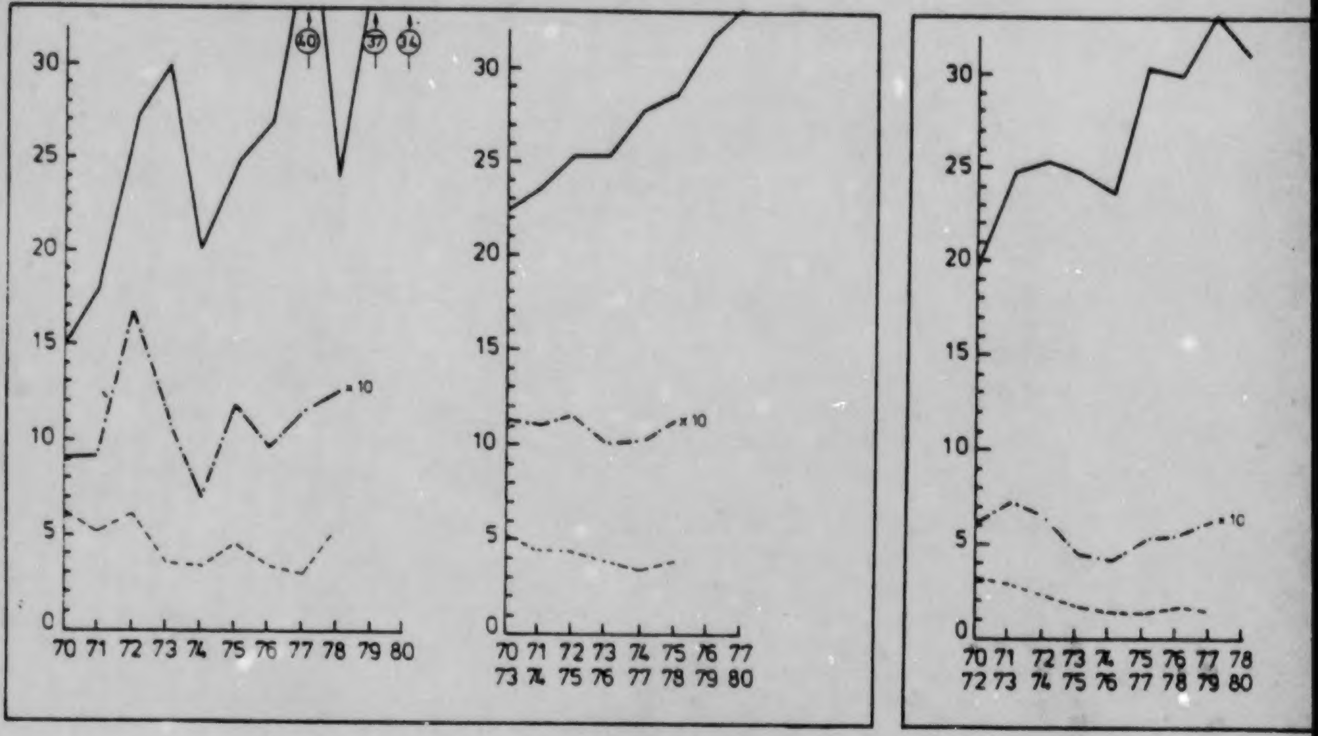

Figure 1 - Example of a trend analysis

Our basic assumptions are that if the annual number of publications decreases (increases), the output of a group is declining (increasing). If the number of short-term citations decreases (increases) this is an indication that the impact of the group is declining (or increasing) and that the group is losing (achieving) connection with the international research-front.

A trend analysis alone is not sufficient to obtain a complete picture of the impact or output of a group, since in principle one cannot distinguish between an increase from 'very low' to 'low' and an increase from 'average' to 'high'. Therefore, the trend analysis is supplemented with analyses that provide some indication of the output or impact level that a research group achieves. Probably the best way to obtain such an indication is to compare Leiden groups with other international groups working in the same field on the basis of their bibliometric scores. However, data on other groups outside Leiden were not available for this study, consequently such comparisons were not carried out. In this study, we approached the problem in another way. Counts of citations to publications of a group have been compared with average citation scores of the journals in which the group itself has published. We assume that this comparison of 'expected' impact with 'actual' impact provides an indication of the international impact level of a Leiden group. Therefore, apart from impact analyses based on citations to publications of a group, the impact of the journals in which groups have published was assessed with the help of citation counts per journal, provided by ISI.

An example of this level analysis (for the same research group as given in Figure 1) is presented in Figure 2. Here we see a comparison of 'actual' and 'expected' publication impact, or, in other words, a comparison of the citations per publication ratio for a research group with the same ratio for an 'average publication' in the journals in which the group published. Only citations received by publications in the third year of their life-time are counted, including in-house citations. Books are excluded as sources of publications and citations.

The solid line indicates the 'actual' number of citations per publication; the dashed line indicates the 'expected' number of citations per publication.

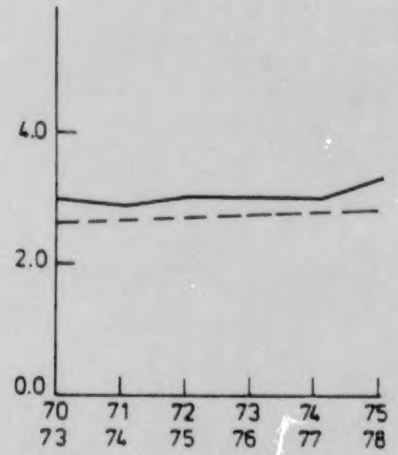

Figure 2 - Example of a level analysis

In this way we obtained a large number of intriguing trend- and level-analysis results of research groups and departments in both Faculties. As discussed earlier, a detailed presentation of this method is given by Moed et al. (1983).

Data Collection and Data Handling Problems

Obtaining complete publication and citation data was by no means an easy task. Several omissions, some due to programmatic or operational errors at ISI, were detected by us and completed at our request by ISI. The number of missing data amounted in the first instance to about 10% of the total number of data involved. However, the nature of some of these errors was such that for several individual departments or research groups the bibliometric data were highly incomplete. The following may serve as an example. Due to some programmatic error, all citations to all publications of a number of journals were missing. These missing citations were about 3% of the total number of citations. However, for a number of specific reseach groups, namely those who published in these journals, this resulted in 50% of the citations being missing.

A complicating factor is that, generally speaking, most of the publications of a research group receive only few citations, while a few particular publications may be highly cited. If one misses such a highly-cited article, citation counts can be most incomplete. A striking example is the following. The Dutch National Survey Committee on Biochemistry evaluated the impact of a Leiden research-group, and appeared to have missed one publication that was cited as many times as the total number of citations that the Committee had collected for this group.

We would like to emphasize the following problem. In regard to the relevance of impact analyses for university research-policy, the research group seems to be the most adequate research-unit. However, these units are rather small (2-10 researchers), and produce relatively few publications and citations. Consequently, bibliometric indicators are often based on relatively low numbers. Small errors or few omissions can lead to dramatic differences in results and interpretations. It follows that one should take considerable efforts to obtain sufficiently complete bibliometric data. If a higher level of aggregation is chosen (for instance large departments, institutes or clusters of departments, or even (sub)faculties as a whole) thereby resulting in larger numbers, say a hundred publications and a few hundred citations, completeness becomes less important. However, bibliometric analyses on such high levels of aggregation are less relevant to research policy at a university level.

Finally, we achieved a completeness percentage of 99% with respect to publications with a Leiden address from the SCI Source-index. The search and selection techniques applied in this project hardly allow for a higher completeness percentage.

We propose 99% as a standard rule with respect the completeness of the publication data in impact-evaluation studies of (small) university research-groups. With respect to the citation data, a number of manipulations should be carried out in order to examine whether systematic errors were made when they were collected. Since such manipulations can actually only be carried out with the help of computer algorithms, all data should be on computer tapes.

Besides, it should be emphasized that complete university data are indispensable for bibliometric analysis on research group or department level. In order to properly assign publications (and citations) to the research groups from which they originated, one needs complete data on research groups, either the names of all researchers who belong or have belonged to the group, or -- even better -- complete lists of publications per research group. Therefore, we conclude that a very crucial part of this type of university research performance analysis lies in a sophisticated combination of two data clusters: the (ISI) bibliometric data and the university data. As stated before, automatic data handling is a prerequisite to carry out this work efficiently.

Specific Problems in Using Bibliometric Data for Past Performance Analysis

In order to gain an insight into the appropriateness of SCI source-journals and SCI source-books as an adequate tool for bibliometric analyses, we carefully studied the publications listed in annual University Research Reports of each (sub)faculty and determined the percentage of publications in SCI source-journals or books (benchmark year 1979). The following results were obtained.

For the subfaculties Chemistry and Physics & Astronomy, 80% or more of all listed publications are published in SCI source-journals and books. The remaining publications are mainly contributions to international meetings and symposia. For the subfaculties Pharmacy and Biology, and for a sample of four departments in the Faculty of Medicine, the percentage of publications in SCI source-journals and books is considerably lower: 33%, 52% and some 45% respectively. The main reason is that some 25% of all listed publications are written in Dutch. In addition, 26% of the listed publications of the subfaculty of Biology are written in English though published in journals not processed for the SCI. These are mainly publications of the Department of Taxonomy.

For the subfaculty of Mathematics the percentage of publications in SCI source-journals or books is the lowest of all subfaculties: 24%. The main reason for this is that almost 40% of all listed publications are research reports of the subfaculty or of the Mathematical Centre, a national research-institute in Amsterdam. However, these are all published in English.

Therefore, in contrast to Mathematics, calculation of output and impact indicators based on SCI-data presented no problems for research groups in the subfaculties of Chemistry and Physics & Astronomy. Nearly all journals in which they publish are covered.

With respect to research groups in the subfaculties of Pharmacy and Biology, and the Faculty of Medicine (assuming that the four departments analysed with respect to this point can be considered as representative of the Faculty as a whole), the output in Dutch is not covered by the SCI source-journals or books. In our opinion, this is not a serious problem. Since these articles are written in Dutch, they should not be considered as directed towards the international scientific community. From the point of view of university research policy, output and impact on the international research front are aspects in their own right, and this study deals with these aspects. On the other hand it is obvious that impact on a national level cannot be adequately indicated on the basis of SCI-data. The fact that 26% of the listed Biology publications are written in English, though published in journals not processed for the SCI, is of more concern. Taking the language in which they are written as a criterion, these publications are directed towards the international research community, yet the SCI Source-Index does not cover them. A field like Taxonomy (at least the European research efforts in this field) is probably not adequately covered by the SCI. Consequently, it is doubtful whether one can obtain reliable impact and output results based on SCI data alone.

Finally, the fact that almost 40% of all listed publications of the subfaculty of Mathematics are published in research reports, not included in the SCI source-journals or in books, constitutes a problem as well. Again, taking the language in which they are written as a criterion, they are directed towards the international scientific community, however the reports are not published in journals. Possibly the role of the serial (journal) literature for the communication of research findings differs from discipline to discipline. Further research into this problem is needed.

Field and Time-Dependent Disturbance Factors

Dealing with impact indicators, i.e. variables determined (partly) by the impact level of a group, we should keep in mind that these indicators are also influenced by disturbance factors that have little to do with impact as such. In this study, we analysed disturbance actor related to specific citation practices within fields, and factors that are related to changes in the coverage of the SCI-data base.

Main results of these analyses are:

(1) Citation practices appear to differ significantly from field to field. In some fields, researchers tend to cite recent (for instance two-year-old) articles more frequently than in others. For example, an article in the Journal of Differential Equations (Mathematics) contains, on an average, one citation to two-year-old journal articles. Yet an article in the European Journal of Biochemistry contains an average of four citations to two-year-old journal articles. It follows that the probability for a two-year-old article to be cited differs significantly within the two fields mentioned in this example. One should expect -- and one actually observes -- much higher short-term citation levels in Biochemistry than in Mathematics. One of the analyses carried out by our group (Moed et al., 1983) provides an insight into these differences. This analysis is based on data such as those given in the example for a number of fields (defined by the journals in which departments or research groups have published).

We came to the conclusion that differences in citation counts for groups in different fields cannot be interpreted merely in terms of impact. In other words, one cannot establish relative impact by directly comparing citations counts for groups in one (sub)faculty, or even in one department. Disturbance factors due to differences in citation practices can to a large extent affect the numerical values of the citation-based indicators.

(2) Citation practices within fields can also change during a decade. In fact an analysis of the SCI data-base between 1970 and 1980 brings to light that a journal article contains, on an average, an increasing number of citations to zero to two-year-old articles during the decade. Hence, the increase of the average number of citations that zero to two-year-old Leiden articles receive during the decade should be directly proportional to this. We assume that this increase does not reflect an increase of the impact of the Leiden publications.

(3) Considerable disturbances result from the fact that ISI has included more source-journals during the decade and that, as from 1977, non-journal material (books) are also included. The following may serve as an example. Due to the inclusion of the books in 1977, the number of Leiden publications increased by about 10%, with some groups profiting more than others. Moreover, the number of citations received by Leiden articles is affected as well. For some groups, the number of citations doubled, while for others it did not change at all.

We conclude that because of possible changes in citation practices or changes in the SCI source-journals and books, one should be very cautious about interpreting trends in the numerical values of bibliometric indicators as trends in output or impact. It requires a considerable effort and knowledge to identify the effects of these disturbance factors, especially on the level of research groups. It must be noted, however, that we constructed bibliometric indicators (especially those used in the level analysis) that neutralize some of the disturbance factors mentioned above.

To investigate this important problem in the application of bibliometric past performance indicators, we will conduct further research on the distribution of the SCI source-books over the various research fields and on differences with respect to communication practices between fields.

Comments of Interviewed Researchers — Conclusions

Twelve researchers in the (sub)faculties involved were interviewed. These interviews were meant as an 'acceptance test', i.e. to examine whether our bibliometric results and interpretations differed or agreed with the ideas of scientists in the field, whether we overlooked hidden pitfalls and other problems with respect to the bibliometric indicators, and whether the bibliometric results and interpretations provide a meaningful basis for discussion of past research performance of research groups. During the interviews, the researchers saw our results for the first time. They expressed their personal views, therefore, their comments should not necessarily be considered as representative of the view of any (sub)faculty body or of the 'scientific community' within the various (sub)faculties. They made comments that were related to all the issues described above, comments dealt with matters like: what the constructed indicators actually indicate; the type of indicators chosen; the completeness of the bibliometric data; the coverage of the SCI data-base; and to disturbance factors that should be kept in mind in interpreting bibliometric results. We discuss here the main points of their comments; for a detailed discussion the reader is referred to Moed et al. (1983).

To our opinion, the most interesting general result of these interviews is the following. In many cases the interviewed researchers did not reject our bibliometric results and interpretations, but they tried to find explanations for the observed output and impact of the research group. For example, they related a given low impact level of a particular research group to the low quality of the research performed by this group. Or they related the low impact to the fact that the researchers within the group are not fond of the limelight, or do not present their findings in an effective way. They mentioned causes that refer to particular events or circumstances within the groups, such as relational problems between staff members, changes in the permanent staff, or the fact that the group does not have a 'second best man'. In some cases, they thought the observed low impact of groups in experimental fields was related to the fact that they had fallen behind on a technological level. In addition, causes were mentioned that refer to characteristics of research fields, such as a strong competition and complete lack of consensus, resulting in opposition from member o editorial boards of significant journals. So during the interviews many policy-relevant factors were brought to light that otherwise would have remained undiscussed. Our indicators formed a sound basis for these discussions as they gave a concise indication of research performance over a relatively long period, up to recent years.

We therefore conclude that the type of bibliometric analyses carried out in this study can be a useful tool for a unviersity research policy. They constitute a 'monitoring device' with which research groups can be 'followed' over a long time up until quite currently. In principle, bibliometric analyses provide a meaningful basis for the discussion of the performance of research groups with scientists in the field, and possibly also with members of monitored research groups themselves. The analyses enable research policy-makers to ask relevant questions about research groups; to some extent the analyses provide an historical picture to those who are not familiar with the research performed by a group or with the field in which it works. Bibliometric analyses can, in principle, provide a basis for a dialogue between research policy-makers and the researchers of various university groups.

It should be emphasized, however, that there is no straightforward or simple relationship between the results of bibliometric analyses and the nature of future policy decision. In order to make proper policy decision, insight must be gained about the factors or causes underlying the observed impact and output, and about the extent to which these factors can be expected to persist. Bibliometric analyses are not a substitute for background knowledge about these factors. Bibliometric analyses can, in fact, be used to bring these factors into the open through discussions about the analyses with the researchers concerned.

FOOTNOTE

[1] The concept of 'self-citations' or 'in-house citations' can be defined in various ways. The aim of these concepts is to identify citations by authors who work within the domain of direct influence of publishing authors. Clearly each publication has its specific domain. How should such a domain be defined? In this study we used a rather broad conception of 'in-house citations': the domain ('house') consists of all authors (both first and co-authors) of all Leiden publications. Generally speaking, these authors are researchers appointed for at least some years at Leiden University. As well there are researchers who are not affiliated to Leiden University who nevertheless have published together with Leiden researchers. It follows that if such in-house citations are excluded, in fact only citations are counted from source articles of which the first author (from citing articles only the name of the first author is present in our Citation File) did not publish a paper with a Leiden address during the period 1970-1980. In this way we are able to evaluate the impact Leiden publications have outside Leiden. The overall percentage of in-house citations amounts to approximately 31%.

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PROGRAM REVIEWS, PLANNING, AND DATA BASES: THE EXPERIENCE OF A LARGE UNIVERSITY

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In several countries, universities and other post-secondary institutions are paying more attention to the three functions addressed in this paper: program reviews, planning, and development of data bases. Apart from a growing recognition that institutional planning needs higher priority, universities have become more involved in these functions because of the perceived needs to have better data to assist decision making, to demonstrate that they take accountability seriously, and to incorporate reviews as an integral aspect of their operations.

This paper deals mainly with program review procedures by discussing relevant literature and by describing the experience of the University of Alberta, Edmonton, Canada. Since 1980, the program review procedures at the University of Alberta have required that all academic and support units are to be reviewed on a rolling basis. This activity was associated with substantial improvement of data bases. Recognition that program reviews did not on their own yield sufficient information to serve as a basis for planning led to the formation in 1983 of four planning groups -- capabilities and capacities, computing, graduate studies, and new program initiatives -- and to greater commitment to planning at the level of the President and Vice-Presidents.

Literature Overview

The volume of literature on program review in post-secondary institutions is increasing very rapidly. However, by far the greatest amount has been produced in the United States, with only occasional articles appearing in the literature of Australia, Canada and other countris.

Some definitions are required for clarity. "Evaluation" is defined as the extent to which performance of an activity meets preselected criteria. A "review" is more comprehensive, encompassing historical, current and planned developments. "Program" can refer to either an academic program or more commonly to the activities of a department or group of departments. "Program review" can then be defined as a comprehensive description and evaluation of past and current activities of an academic unit as well as scrutiny of proposals for future developments.

Purposes and Use

Several purposes of program review, not all of which are mutually exclusive, have been identified by different authors:

1. To inform decision makers about a program's strengths and weaknesses (e.g., Peterson, 1980; Dressel and Cammack, 1972).
2. To provide information for departmental and central university planning (e.g., Cochran and Hengstler, 1984; Nicols, 1982).

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3. To establish a program's status relative to either specified standards or performance of other similar programs (e.g., Council of Graduate Schools in the United States, 1979).

4. To arrive at judgments about a range of decision alternatives concerning the continuation, modification or termination of a program (e.g., Jany and Keller, 1981; Peterson, 1980).

5. To assist an institution when it is forced to reduce expenditures and/or increase efficiency (e.g., Barak and Berdahl, 1978; Bélanger and Tremblay, 1982).

6. To demonstrate accountability (e.g., Barak and Berdahl, 1978). Feasley (1980) has summarized these purposes as planning, improvement, and justification.

As stated above, the extent of use of program reviews has increased rapidly, especially in the U.S. In 1982, Barak reported that the 1975 speculation of the Carnegie Council that much more reliance would be placed on program review in the future was borne out by a 1980 survey conducted by the National Center for Higher Education Management Systems (NCHEMS). Of 1,082 institutions that were surveyed, 82% had adopted some type of formal process for reviewing programs, with 43% of these having adopted their present policies and procedures since 1975. McCorkle and Archibald (1982) concluded that "program review is now more formal, more frequent, and more comprehensive in scope and depth than in the past." The need for this trend to continue is supported by Arns and Poland (1980) who perceived that universities, being complex organizations of "considerable inertia", require evaluation in order to ascertain how they can respond to societal changes.

Cost-Benefit Aspects

In keeping with current organizational practice, most universities attempt to make some cost-benefit estimate before embarking upon program reviews. Hoyt (1980) stated that reviews force examination of frequently ignored matters, provide qualitative balance to numbers, involve program participants in a healthy way, point to constructive changes, and create a positive institutional image. Increased receptivity for change has been identified by Dressel and Cammack (1972) as a positive consequence. This often results when unit members are involved in production of a detailed self-study report. McCorkle and Archibald (1982) have argued strongly that routine reviews produce less stress than do *ad hoc* reviews, and can place proposals for change in a positive context. Their approach was supported by Craven (1980) who urged that a self-study of each academic program should be undertaken every five or six years. On the cost side, certain administrative expenses -- e.g., salaries, honoraria, travel -- are obvious. Less obvious are the hidden costs of increased workload by members of the unit being reviewed. Hoyt (1980) has also identified negative consequences generated by erroneous evaluations, a feeling of paranoia, reduction in morale, and the replacement of intrinsic motivators by extrinsic factors. To increase the cost-benefit ratio, Hoyt (1980) advocated that the university should concentrate upon major objectives, collect only the most relevant data, use a credible, acceptable review system, and ensure that communications are effective and timely.

Practices at Selected Universities

The program reviews of the University of Illinois at Urbana-Champaign (1980), which are organized by a Council on Program Evaluation, are well known. These have considerably influenced developments in other universities, especially through conferences and consulting. During 1973-75, the Council on Program Evaluation, which was composed of nine faculty members, two graduate students and two undergraduate students, conducted evaluations of units using task groups of at least seven faculty members and one or more students. Because this procedure was very demanding of human resources, it was modified for 1975-78 to emphasize self-evaluation for academic units while retaining task groups for specialized evaluations.

Other universities have taken different approaches, which vary in aspects such as the purpose and timing of reviews, means of coordination, relationship between internal and external reviewers, publication of reports, extent of the review activity, and the methods used to review administrative/ support units. Both the University of Vermont and Ohio State University (Arns and Poland, 1980; DiBiasio and Ecker, 1982) emphasized that the purpose was program improvement: their processes included flexibility in collecting information, a self-study report, open communication, feedback, and development of a Memorandum of Understanding which described the steps, time-frame and costs to meet the accepted objectives for program improvement.

At the University of Saskatchewan (Canada), reviews of colleges (Faculties) began in 1976 when the term of a dean expired. These reviews were organized by the University Studies Group under the control of a Supervisory Committee on College Reviews. A different approach was used by the University of Calgary, which, after conducting some ad hoc reviews of faculties, appointed a University Program Review Committee "to analyze the current status of the University and to develop an appropriate program for the decade ahead" (University of Calgary, 1980). Each Faculty was analyzed in depth in 1979-80 by teams of Committee members.

Some universities use review teams which include both internal and external members, whereas others, such as the University of Minnesota, use separate internal and external committees. Another variation involves the scope of coverage; some institutions review both undergraduate and graduate programs of a department, while others commonly only review the graduate programs.

Based upon the 1980 NCHEMS study cited, Barak (1982) identified these generalizations:

1. A few institutions include reviews of research programs and support departments.

2. Reviews are becoming more rigorous, leading to improved results.

3. More data are being incorporated into the review process.

4. Reviews are becoming more important in institutional decision-making and planning.

5. Outside peer faculty are usually involved in the review teams.

6. Deans of Faculties usually organize the reviews.

7. Students, graduates and former students usually serve as participants in surveys rather than as members of organizing or reviewing committees.

8. The support of the president and trustees for the review process is essential.

9. Programs are selected for review at convenient times or when their turn comes up in a cycle. Some institutions favor combining reviews with accreditation visits, whereas others discourage or forbid this practice.

10. The concept of "quality" and its assessment leads to considerable disagreement.

11. Most reviews are perceived to be beneficial.

In comparison with the widespread use of reviews of academic units/programs, the reviews of administrative/support units are considerably less well developed. The University of California is a notable exception to this generalization (Griffin and Burks, 1976). Also, the University of Minnesota and the University of Illinois at Urbana-Champaign are both establishing detailed procedures for administrative/support reviews.

Procedures at the University of Alberta

Development

In 1908, the University of Alberta was founded in Edmonton, Canada. Its first serious planning efforts began in 1965; since then, several planning initiatives have been undertaken. Institutional research activities also began in earnest about 1965, whereas program review was not undertaken at the University of Alberta in any comprehensive manner until 1980.

A Universities Priorities Committee was established in 1977 in response to concerns that appropriate resources should be allocated to all units on campus. This committee noted that planning in the 1960s and 1970s had focused on incorporating new programs and that the University had neither a set of priorities nor data upon which priorities could be established. Consequently, it recommended that a system of reviews of all programs and units be initiated. This recommendation was adopted by the University along with the directive that the Office of Institutional Research and Planning develop an improved data base to assist decision making.

A committee was established to develop terms of reference for the reviews. After spending considerable time in evaluating the procedures used at several other universities and in discussing alternatives, this committee recommended that simple procedures be adopted which would not interfere with the established decision-making structure. Its final recommendations, which were approved with only one change, were essentially as follows:

1. The goal of the reviews should be production of information that serves as a reliable basis for planning and improvement of programs.

2. The administrative structure should be readily understood, effective, efficient, responsive, flexible, credible, and realistic.

3. A President's Advisory Committee on Academic Reviews should be established, consisting of a chairman, the Vice-President (Academic), and two other members selected by the President.

4. The primary tasks of this Committee should be as follows:

   (a) to advise the President on the order in which units should be reviewed and on the composition of reviewing teams;

   (b) to advise reviewing teams on the review requirements;

   (c) to transmit reports of reviews to the President; and

   (d) to keep the university community informed about its work.

5. Individual Unit Review committees should be appointed, consisting of one member from outside the University but of the same discipline, one from a related discipline within the University, and one from the University at large. (The number of "outsiders" was later changed to two.)

6. Each unit to be reviewed should prepare a Self-Study Report.

7. The reviews should be conducted over several years.

8. Each Unit Review Committee should be expected to consult actively with undergraduate and graduate students, academic and non-academic staff, and recent graduates and employers of graduates where appropriate.

9. Responsibility for monitoring action taken with respect to recommendations of the Unit Review Committees should rest with the Vice-President (Academic).

In response, the President in 1980 appointed a President's Advisory Committee on Academic Reviews (PACAR) consisting of a full-time chairman, two professors and the Vice-President (Academic). A deliberate decision was made to appoint a chairman who was not a central university administrator. Further discussions led to the decision that reviews of administrative/support units should be organized by PACAR so that a global view of inter-unit relationships could be obtained and costs minimized. The name of PACAR was subsequently changed to President's Advisory Committee on Campus Reviews (PACCR), and the Director of Technical Services was added to the Committee.

As of 1 June 1984, 61 units were in various stages of the process, with 25 completed, 10 more had received site visits, and 26 were in the Self-Study phase.

Principles

Early in the developmental period, the following important principles were endorsed by the President and widely publicized.

1. The University's attitude in conducting reviews will be to promote forward-looking change and to encourage high-quality scholarship.

2. Multiple benefits will be expected, such as improved planning and awareness of operations.

3. Considerable flexibility in the different phases will be emphasized, with a minimum of directions being provided.

4. While the procedures are being developed, a limited number of units will be reviewed.

5. The PACCR and accreditation reviews will coincide whenever possible to avoid duplication.

6. Sensationalism will be avoided and confidentiality respected. PACCR

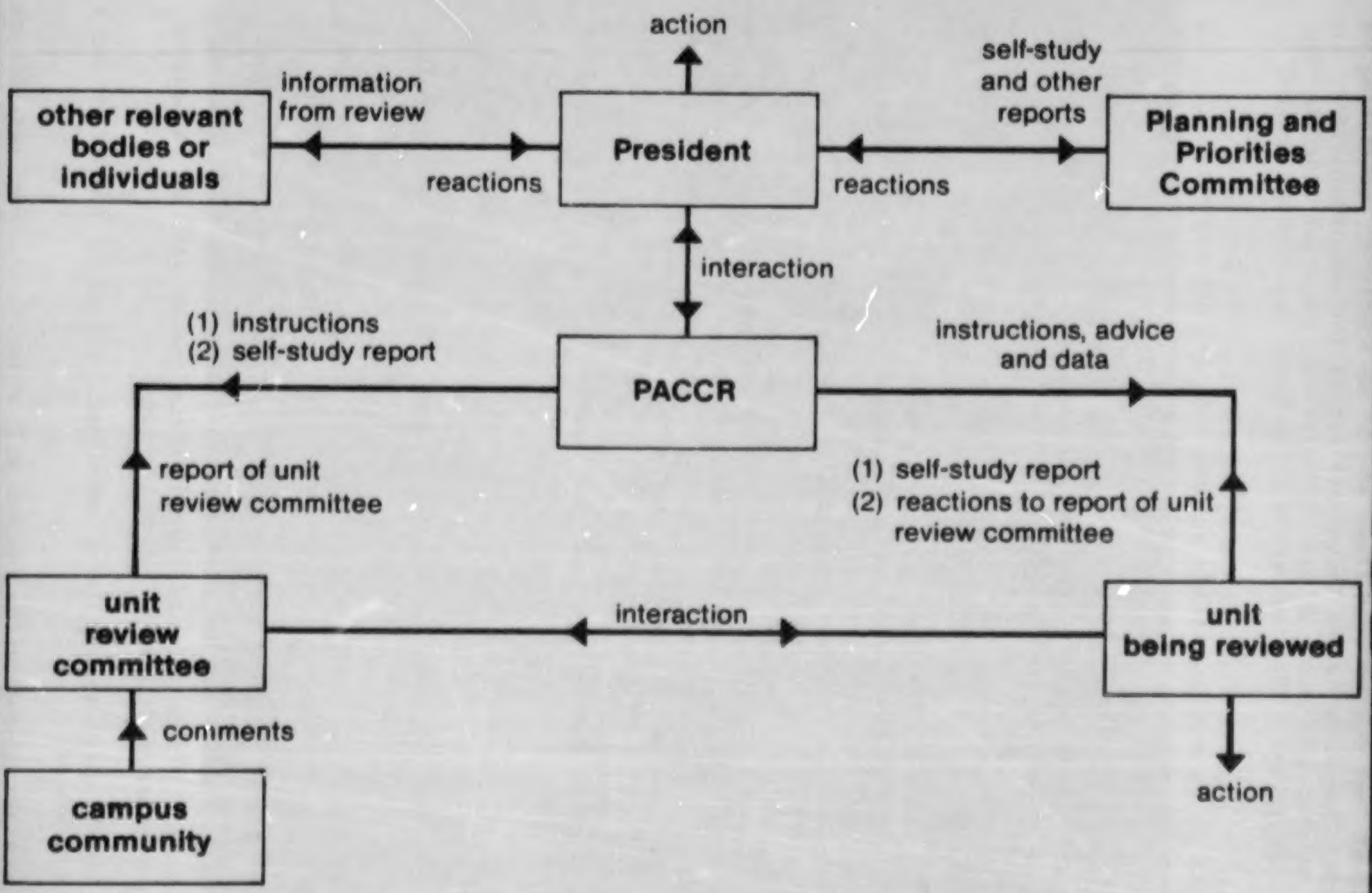
action
information from review
self-study and other reports
other relevant bodies or individuals
President
Planning and Priorities Committee
reactions
reactions
interaction
(1) instructions
(2) self-study report
instructions, advice and data
PACCR
report of unit review committee
(1) self-study report
(2) reactions to report of unit review committee
unit review committee
interaction
unit being reviewed
comments
campus community
action

Figure 1. Simplified representation of the overall review process at The University of Alberta.

decided that numerical data would be important in the review process, but that a balance of data, descriptive information and evaluation were necessary for effective reviews.

Procedures

The overall approach taken at the University of Alberta is shown in Figure 1. Many aspects of this process are as described earlier. Each unit sends its completed Self-Study Report to PACCR. PACCR then sends recommendations for members of the Unit Review Committee (URC) to the President after consultation with the unit. Copies of the Self-Study Report are forwarded to the URC, which meets on campus about one month later. It spends between two and four days in interviews, visits and meetings. One to two months later, the URC submits a report to PACCR. With the approval of the President, this URC Report is sent to the unit which is invited to submit a response. Finally, the Self-Study Report, the URC Report and the response of the unit are discussed by the Planning and Priorities Committee. However, action can be taken by the President and the unit at any stage of the process.

The unit to be reviewed receives advice sheets from PACCR concerning the Self-Study and resulting report, selection of members of the Unit Review Committee, conduct of the on-site review, as well as standardized information from the Office of Institutional Research and Planning showing ten years of academic and other data, and five years of budget data. Advice is also provided to students about how they can provide effective input. Invitations are extended to the University community to provide confidential, written comments about the unit to be reviewed.

Self-Study Phase. This typically takes about six months, and has been, as other universities have experienced, very demanding of staff time. Units are asked to address these matters -- their history, current status, impending changes, future prospects, strengths, weaknesses, and limitations. They are also requested to be frank so that maximum improvement can result. This has usually occurred, yielding realistic, balanced Self-Study Reports.

Unit Review Committee. The unit to be reviewed nominates five to ten possible external reviewers who are expected to possess excellence in their field as well as objective and trusted judgment. All four reviewers must be acceptable to PACCR and the President. These current instructions to reviewers have changed little since 1980:

> Without intending to restrict the scope of the review, we should like to have drawn to our attention what, in the opinion of the members of the Unit Review Committee, are the strengths and weaknesses of the department's teaching and research programs, an assessment of the staff and staff workloads, the adequacy of resources provided, the effectiveness of the organization of the department, and the relations of the department with others. In particular, we should appreciate having drawn to our attention any opportunities the URC perceives for improving the department's programs, its relations with both internal and external organizations, and for better utilization of resources available. We also ask for your judgment of the department's proposed plans for the future.

Issues

Experience with reviews over the past four years has identified several issues of importance to the University of Alberta and of relevance to those interested in analyzing review procedures and consequences in different institutions.

One initial concern was that involving unit members in nominating URC members could lead to collusion, that is, the reviewers might not be as critical as the circumstances require. However, this concern has not materialized. Careful selection identifies reviewers of a high standard possessing the requisite general wisdom, scholarly knowledge and collective judgment to produce a sound report having maximum impact. A related concern, which was less readily anticipated, involves the availability of external experts to serve on Unit Review Committees. Most of these committees spend two full days on campus, whereas others spend three or four, with approximately equal amounts being spent in the unit, outside the unit, and in committee discussions. Because most of those identified as suitable reviewers are highly respected scholars who are much in demand, assembling a team on campus for more than the two days is sometimes difficult.

A different concern involves how central University administrators can place priorities on claims for more resources made by units in Self-Study Reports and supported by the Unit Review Committees. How can a University decide what is an equitable workload in its different academic units? We recognize, as do other universities, that the primary purpose of program improvement can sometimes be achieved without allocating further resources. But, because in other cases, improvement cannot occur without increased resources (Craven, 1980), the University of Alberta annually reserves funds which allow the President to react concretely to some review recommendations. Another function, unanticipated in the planning phase, is the reliance of the President and Vice-President upon the PACCR Chairman for advice concerning resource allocation, because he has gained a detailed knowledge of the campus and its strengths and weaknesses.

Related to the resource issue is the attempted determination of the effect upon actual workloads of variations in aspects of instructional activity such as hours spent lecturing, size of class, level (junior or senior undergraduate; postgraduate), and the relative weighting of lectures, seminars and laboratories. Many of the Self-Study and URC Reports comment upon the heavy instructional workload of faculty members. This informed judgment is a useful supplement to the usual numerical measures of teaching load. At the University of Alberta, and probably at all other universities, a wide variation in teaching load occurs across departments, although some institutions, such as the University of Texas at Austin, have introduced formulas in an attempt to reduce this variability.

The relationship between teaching and research is another important concern. These functions are commonly and defensibly viewed as separable activities by universities (Conyea, 1980) and by review committees. However, especially at the senior undergraduate and postgraduate levels these two activities frequently blend into each other. Research often includes informal teaching of graduate students who are involved with their supervisors' projects. We should recognize that a heavy commitment to one or other function can adversely influence performance on the other.

Finally, concern has emerged about how administrative/support units, such as Personnel and the Registrar's Office, can best be reviewed. The problems encountered in reviewing them are generally different from those of academic units. They are often extremely complex with large staffs, they perform many diverse activities, and they interact with most of the units on campus. Most universities have paid less attention to reviews of administrative/support units than to those of academic units, but this situation is gradually changing. Our experience is that coordination of these reviews under one organizing committee has many advantages.

Recent Planning Activities

In 1983, the University of Alberta's Vice-President (Academic) noted that although planning is an intensive, continuous activity in most areas of the University, no concerted planning activity had occurred since 1971. He observed that neither the PACCR program reviews nor the 1982 review of the University's purpose by the Senate met the "strongly felt need for an acceptable, flexible, on-going academic strategy" which would include physical, financial and administrative components (Baldwin, 1983). After concluding that a mismatch presently occurred between resources and mandate, the Vice-President proposed that the University's senior administrators rather than its established planning bodies were best suited to meet the current planning needs, and to provide the stimulus needed to devise new methods of meeting needs. The intent was to develop a general planning strategy, rather than a single planning document, within which units would then develop their own proposals. The specific proposals were as follows:

1. That a planning steering group be established, consisting of the President, Vice-President (Academic) and the Vice-President (Finance and Administration).
2. That the Vice-President (Academic) have chief operational responsibility for planning.
3. That Institutional Research and Planning give priority to the needs of this planning activity.

These proposals were approved by the Board of Governors. Detailed discussions involving representatives of academic and administrative/support units on campus led to further agreement on these matters:

1. In view of the existence of documents such as the Senate Report on University Purpose, time need not be spent in preparing a Mission Statement.
2. A "broken-front" approach will be used, in which four Planning Groups will focus upon capacities and capabilities, computing, graduate studies, and new program initiatives, rather than an overall approach.
3. The planning approach will be data-assisted rather than data-driven.
4. Large-scale central reallocations of resources will not occur.
5. All units will be urged to increase their planning efforts immediately, and to submit periodic reports to the Vice-President (Academic).
6. The University's existing data bases will be reviewed.

Currently, the major planning activity is being undertaken by the four Planning Groups, each of which consists of twelve broadly representative members. These groups are focussing on both short-term and long-range planning issues, and will soon be collecting a limited amount of data from the heads of all units.

Institutional Research and Planning

At the University of Alberta, the main functions of the Office of Institutional Research and Planning are to provide information which will be of assistance in decision making, e.g., in annual budget allocations, and in increasing awareness of campus conditions, e.g., in surveys of opinions. For PACCR activities, the Office provides standard data for each unit at the beginning of its Self-Study, as well as additional, requested data, which frequently require new analyses. For the new planning activities, staff have been involved as resource members to three committees by participating in meetings, assisting in questionnaire construction, providing information, and conducting additional analyses. Improvement in University data bases has recently involved these areas -- research grants and contracts; graduate student records; fellowships and scholarships; student flow models; and preparation of detailed information about the operations of each faculty and department.

Concluding Comments

The various sectors involved in program review at the University of Alberta generally have positive reactions towards the experience, and the goal of program improvement has usually been accomplished. This success is probably attributable in large measure to careful planning, the desire of the President to move slowly and to avoid sensationalism, and the competence of members of PACCR. But the somewhat slower than expected progress, approximately fifteen reviews each year, has meant that conclusions of the program reviews have not been as significant in overall planning as was originally hoped. Extensive complementary planning activities have therefore become necessary. Learning from the experience of other institutions, a selected approach to areas in which planning should be concentrated was chosen. Also, most of the planning direction is to come from senior administrators after receiving input from all sectors. Reliable, comprehensive data bases are now acknowledged to be essential if both planning and program review are to be successful. The role of the Office of Institutional Research and Planning is therefore becoming increasingly important, its analytical functions more complex, and the data bases that it uses more comprehensive and sophisticated. Other universities engaged in these three activities will probably have similar experiences.

ACKNOWLEDGEMENT

A great deal of the content of this paper is similar to that in the 1983 Canadian Journal of Higher Education article by Harris and Holdaway, listed in the References. The collaboration of Dr. Harris of the University of Alberta in this activity is gratefully acknowledged.

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MATHEMATICAL AND STATISTICAL MODELLING:
THE CAREFUL PATH BETWEEN ENTHUSIASM AND SCEPTICISM

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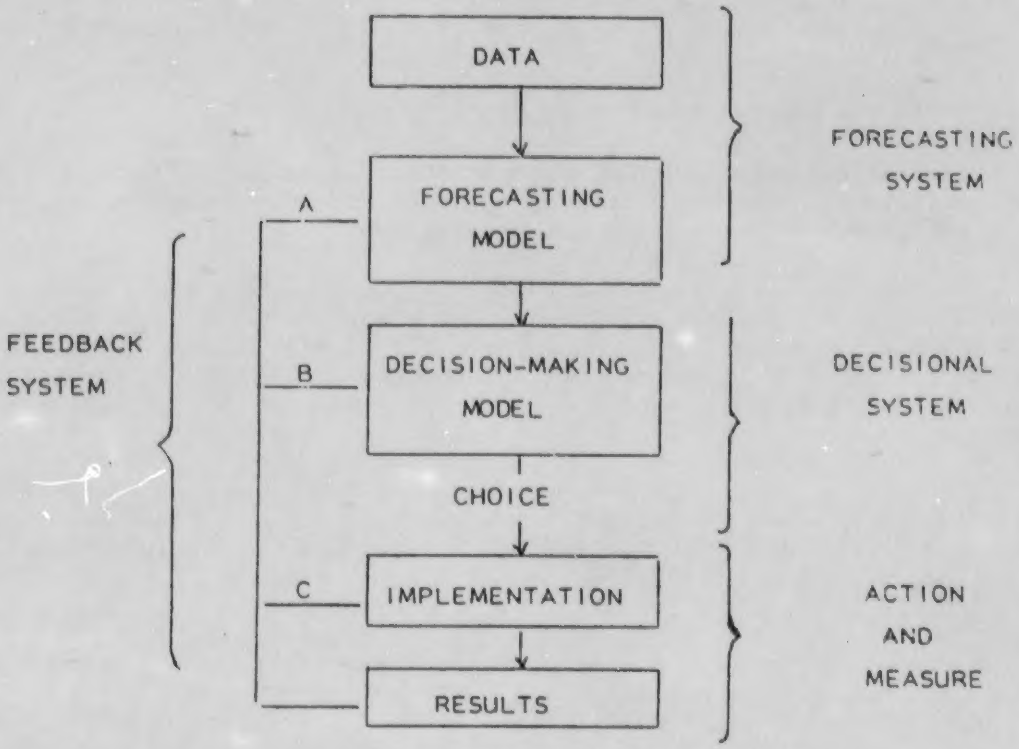
Forecasting is always betting, even if statistical and mathematical models can be considered as uncertainty reducers. Careless use of models may often be the source of dangerous mistakes in decision-making, and the mathematical sciences cannot be held as responsible for inaccurate or thoughtless applications. Therefore, my purpose is to reflect on the elementary conditions to be considered so that the mathematical tools will not be betrayed by the information and that the decision-maker will not be betrayed by an error in the choice of the tool.

First, the set of every forecasting/decision-making process has to be considered in a global scheme including a feedback process. This scheme can be described as follows, for instance Figure 1.

Figure 1

Forecasting/Decision-Making System

(adapted from Ch. T. Horngren: Cost Accounting, A Managerial Emphasis, Prentice-Hall, 1978)


DATA
FORECASTING MODEL
DECISION-MAKING MODEL
CHOICE
IMPLEMENTATION
RESULTS
A
B
C
FEEDBACK SYSTEM
FORECASTING SYSTEM
DECISIONAL SYSTEM
ACTION AND MEASURE

The feedback system is too often restricted to (c), control of implementation and comparison between predicted and actual results, which implies a total confidence in the forecasting and decision-making systems.

I - Data Selection and Correction

The forecasting model has to be fed with data -- those data must be:

- relevant
- homogeneous

Relevance is not the major problem with time-series analyses. Data which give a good description of the past usually give a good description of the future unless:

- the observed phenomenon has not been subject to unrepresentative influences at some periods,
- or is not supposed to have any reason to be subject to such influences in the near future.

Any break in a rhythm must be analyzed so that one knows if it is temporary or not.

The problem of relevance is more acute in the field of correlation to an exogeneous phenomenon:

- if an observed correlation is a consequence of a random event, there is no reason that it should go on;
- if it is the product of a double correlation with a third phenomenon, one must be able to predict that both underlying correlations have no reason to change.

In any case, a causality analysis is necessary.

Finally, data obtained by statistical sampling must be considered carefully for the simple reason that statistical analysis implies the respect of a set of rules which are tremendously difficult to apply.

The sampling bias, which cannot be measured and, by the same token, cannot be taken into account, is often much more important than the statistical sampling error. In Paris in the old days, a survey concerning the professions of the inhabitants of the city gave this result: more than 40% doormen ... simply because the samplers were too lazy to go up the staircases!

Using accounting information can also be a source of trouble: historical costs, rules of caution, fiscal influence ... there are many reasons why information from economics may be biased. Even cost accounting is suspect when using proration ratios.

Homogeneity of data may be approached only when several conditions are met.

1) Homogeneity of the phenomenon to be measured

Has everything stayed subject to the same conditions during all the period of observation? If not, either eliminate outdated data or try a decomposition into homogeneous subsets.

2) Homogeneity of the measurement unit

If usually respected by physical units, this rule is often broken in case of statistical aggregates and always in case of monetary units.

- Statistical aggregates may be subject to changes in definitions of categories, as well as to changes in the contents (composition of an index, for instance). In both cases, one has to use linking series when they exist or, if not, to eliminate outdated data.
- Money is obviously the main source of heterogeneity. Besides the problems related to exchange rates in international comparisons, and everybody knows the importance of this problem, a national currency is subject to two causes of measurement error:

i. Inflation which is supposed to influence the price of everything at the same rate, but differently at different periods;

ii. Variation of relative prices which records the fact that the price of goods or services follow a specific evolution, independently of inflation.

Let us take the example of a firm selling oil and refrigerators:

The global sales evolve as follows:

Year	1973	1974	1975	1976	1977	1978	1979	1980	1981
$	16300	17700	19450	20900	23600	26400	29350	32000	30700

The yearly and cumulated inflation rates are:

8%	10 %	10 %	12 %	12 %	10 %	10 %	8 %
8%	18.8%	30.7%	46.4%	63.9%	80.3%	98.3%	114.2%

So that the sales in constant 1973 $ are:

16300	16390	16370	15990	16120	16100	16280	16140	14330

Now, imagine stable sales in constant $ from 1973 to 1980 of around $16,200 and we have two options for 1981:

- either it is an accident and, knowing that the expectd rate of inflation for 1982 is 6% (cum. 127%), we forecast 16,200 x 2.27 = $36,770
- or we have some reasons to guess the starting point of a decrease and we forecast much less!

But, the full set of data is:

Year		1973	1974	1975	1976	1977	1978	1979	1980	1981
	Q	1,050	1,000	950	900	850	800	750	700	650
Oil	P	6	10	11	11	14	18	21	24	23
	S	6,300	10,000	10,450	9,900	11,900	14,400	15,750	16,800	14,950
	Q	50	70	90	110	130	150	170	190	210
Fridges	P	200	110	100	100	90	80	80	80	75
	S	10,000	7,700	9,000	11,000	11,700	12,000	13,600	15,200	15,750
Total		16,300	17,700	19,450	20,900	23,600	26,400	29,350	32,000	30,700

Now, the quantitative evolution is clear and, if we know a few things about economic conjecture and the sales policy of the firm, we can have the price information for 1982: oil - \$22 and refrigerators - \$75, so that we can predict relatively safely:

Oil:	600 x 22	=	13,200
Refrigerators:	230 x 75	=	17,250
Total sales \$		=	30,450

Testing the relevance of data and giving homogeneity to series of figures requires considerable work and needs much rigor and precision. However, any deficiency or any careless approach in this work will cause a lot of trouble in the subsequent operations of forecsting or deciding.

II - Choice of the Models

Whatever its purpose, a model can be defined as a simplified representation of an actual phenomenon which is complex and imperfectly known. In any case, we probably have a rather large choice of models for solving the same problem, and it is important to define the conditions of selection of the most accurate one.

General Conditions

The choice of a model is mainly a question of goals and constraints.

- Most of the constraints concern applicability.
  First of all, will we get all the required data, or will we have to play with dangerous estimates or deadlocks which will destroy the reliability of our results?

Are those data available under the required statements?

- Cost constraints are also very important and often difficult to measure. It is obvious that a model is worthwhile only if the advantages it brings are greater than its cost. But it is not so easy to measure this cost, which includes the cost of the changes brought with associated innovations.

- The choice of a model according to the goals may also be a source of ambiguity, for the reason that goals themselves are not always clearly defined and expressed: either because there are implicit goals unknown to the consultant which override explicit goals, or because the explicit goals are contradictory.

- Finally, the way the model takes into account the risk is fundamental, as the utility of a result is not a linear function of this result. Specially, there is a level of bad result for which the existence itself of the organization is brought into question, and the risk attached to this result must be known. Deterministic models and models giving a mean value do not allow one to estimate the probability of this result. This is the reason why it is worthwhile to choose probabilistic models, and even uncertainty models, since it is more valuable to know that the fatal risk exists, even if we don't know its probability, than to ignore its existence.

Conditions of Feedback

The general process of feedback, when the actual results of an action are known, starts necesarily from the process of forecasting. The key questions for evaluation are:

- were my data good? Which means, under the light of the facts, were they accurate, relevant and homogeneous?

- was my forecasting model correct? i.e., were the retained variables explanatory, was the shape of the model representative of reality? Did the forecasted results bring us to correct conditions of choice?

Then we have to analyze the process of deciding: was it adapted to the goals? Did it bring us to the most rational decision? Then, and then only, can we start the process of feedback of implementation and action, usually in terms of variance analysis.

Thus, using mathematics and statistics for decision-making appears to be a mix of lucidity, suspicion and intuition and the model user must show a careful and "sceptical enthusiasm":

The model is a **GUIDE**, but never a **CREDO**!

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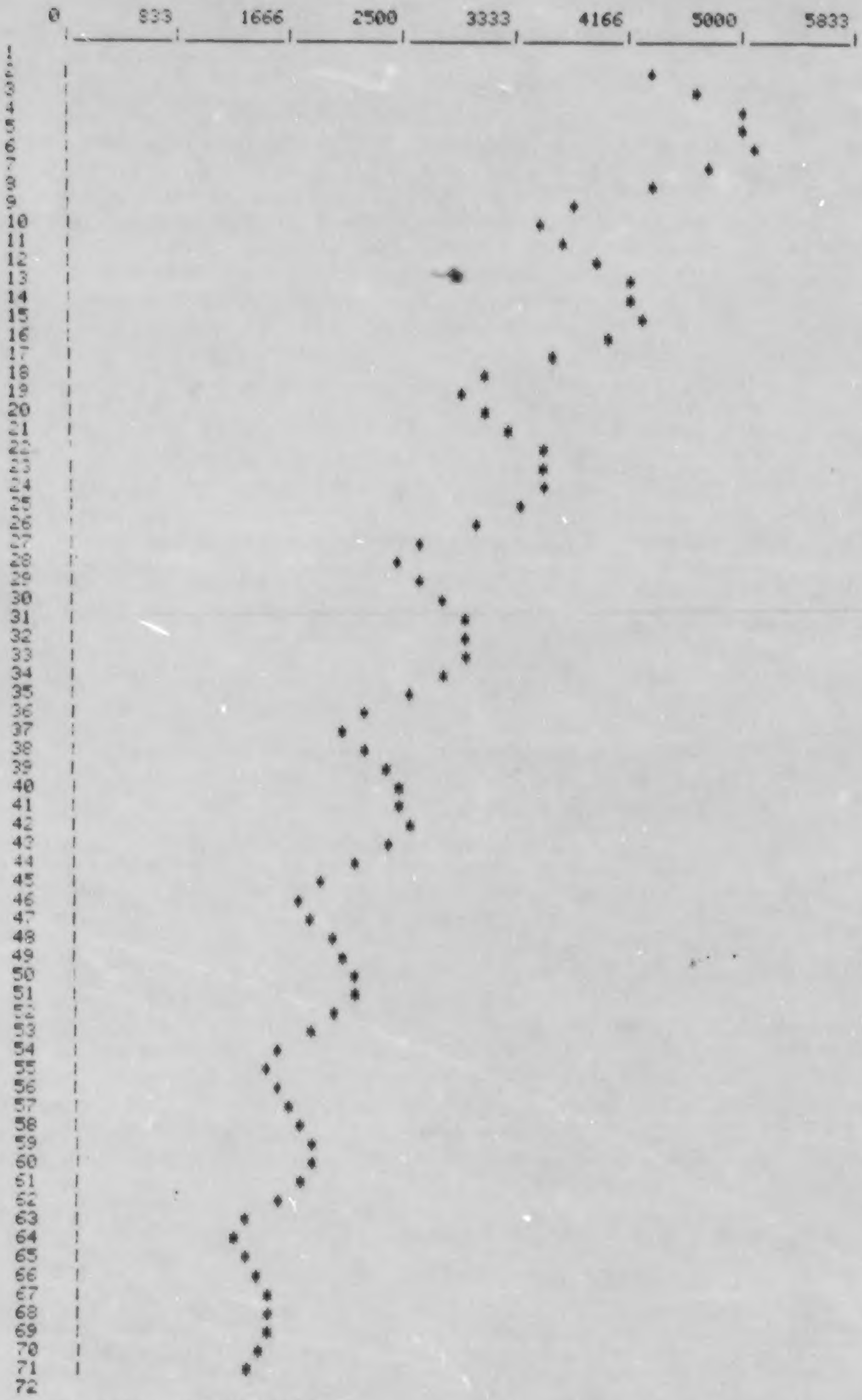
Graph of Mobil Seasonal Means



Parameters of the Exponential Fonction

Basis	.98
Multiplicat. Coefficient	5010.31

Periodical Coefficients

Coef. Per. 1	.83
Coef. Per. 2	.89
Coef. Per. 3	.99
Coef. Per. 4	1.06
Coef. Per. 5	1.09
Coef. Per. 6	1.13
Coef. Per. 7	1.08
Coef. Per. 8	1
Coef. Per. 9	.88

Computation of Seasonal Coefficients

Seasonal Coefficients

Seasonal Coef. 1	.92
Seasonal Coef. 2	1.2
Seasonal Coef. 3	.86

Std Dev. of the Adjustment	1.43

Forecasted Values

Forec. Per. 73	890.58
Forec. Per. 74	1212.69763
Forec. Per. 75	945.774453
Forec. Per. 76	1067.9495
Forec. Per. 77	1396.77253
Forec. Per. 78	1016.74388
Forec. Per. 79	1025.2009
Forec. Per. 80	1197.99686
Forec. Per. 81	746.947958

Example 1

Student enrollment forecasting: a time-series analysis

Using time-series analysis can be a powerful tool for forecasting from historical data when one suspects seasonal or cyclic variations following a regular trend. But it is probably the area where one has to be the most careful about the relevance of data as well as about the adequacy of the statistical model to the specific problem.

1. As one assumes the homogeneity of the data (i.e. is the measurement unit constant), one also assumes the homogeneity of the behaviours, which are necessarily supposed to follow the same laws during the whole period of observation. If not, let us take a shorter period during which the assumption can be made.

2. As to the shape of the model, one has to notice that too often in time-series a linear trend is assumed, whatever the actual shape of the trend could be. So one needs to choose a model where mobile means are the first step of the analysis so that one can see their trend before choosing the mathematical function which is the closest to their evolution.

Example: At the University of Kon-tiki Beach, the department of sub-marine studies is declining, but the monthly evolution of the number of actual student credit-hours apparently follows a law that one can try to analyse with a view to forecasting the educational effort which will be necessary in 1984.

For the last eight years the data are as follows:

Term	Month	1976	1977	1978	1979	1980	1981	1982	1983
1	O	3528	2941	2452	2044	1704	1421	1185	988
	N	5186	4323	3605	3005	2506	2089	1742	1452
	D	4235	3531	2944	2454	2046	1706	1422	1186
2	J	4565	3806	3173	2646	2206	1839	1533	1278
	F	5965	4974	4147	3457	2882	2403	2003	1670
	M	4384	3655	3048	2541	2118	1766	1472	1228
3	A	4687	3908	3258	2716	2265	1888	1574	1312
	M	5104	4255	3548	2958	2466	2056	1714	1429
	J	3001	2502	2086	1739	1450	1209	1008	840
Years	Total	40655	33895	28261	23560	19643	16377	13653	11383

One assumes that the declining trend has no reason to change. The Table shows that in the nearness of the summer holidays the students seem to prefer the beach to the classrooms, and that they are present more at the university in the middle of each term than at the beginning or at the end.

[The program has been realized by Claude COSSU, University of Nantes (France)]

Example 2

Costing and multilinear regression

When a unit has no cost accounting system, multilinear regression can be a simple method to have an approach of its cost function.

Before starting, one has to make sure that:

- the data are pertinent and homogeneous (constant dollars, same measurement units, ...)
- the structural elements which are not retained in the model have been stable during the period of observation.

After treatment of the historical data, the first step consists of defining the possible causes of variation of costs:

Let x_{ij} $\left\{ i \in (1,\ldots\ldots,n) \right\}$ be the quantities of those n causes for the period j;

So, the cost function to test is:

$$C = \sum_{i-1}^{n} a_i x_i + a_o + u$$

where:
- C : estimated cost
- a_i : variable cost of the cause i
- a_o : fixed cost
- u : random element representing the causes which are not retained in the model (U is supposed to be gaussian and to have a mean equal to zero).

In the second step, use the method of least squares to have the best estimation and statistical tests (t-Student, F-Snedecor, ...) to have an idea of the quality of your model. If they are not satisfactory, you can change your explanatory variables until you get the best model.

Example: The head of a department thinks that the global cost is influenced by:

- S : number of full-time equivalent students,
- F : number of FTE faculty staff,
- B : number of square feet built.

He has obtained the following data:

Year	Cost (C) (1984 $)	FTE Students (S)	FTE Faculty staff (F)	Built Square feet (B)
1972	245,600	500	50	40,000
1973	278,800	580	60	50,000
1974	290,500	620	63	50,000
1975	331,100	670	70	68,000
1976	341,700	710	70	68,000
1977	371,100	740	75	80,000
1978	363,500	750	75	80,000
1979	367,800	760	75	80,000
1980	368,000	755	74	80,000
1981	349,600	750	72	70,000
1982	346,900	753	70	70,000
1983	344,600	748	69	70,000

[The program of multilinear regression comes from Xuan Tung Bui (Le basic pour l'entreprise. Ed.: Sybex, Paris, Berkeley)]

Example 3

Multicriteria analysis: MARSAN-ELECTRE

MARSAN-ELECTRE is a French method for decision-making according to several criteria.

Its basic principle is:

> If an action A is better than another action B according to the majority of the criteria and in addition, there is no criterion according to which A is considerably worse than B, then we can say, without too great a risk of error, that A outclasses B.

Thus, the algorithm of decision-making rests on two conditions:

- One condition of concordance:

$C_{A/B}$ = Sum of the weights of the criteria for which estimates show a preference for A against B, divided by the sum of the weights of all criteria.

Correlation Matrix

1			
.97	1		
.98	.95	1	
.98	.93	.96	1

Variable	Mean	Std Dev.
Cost	333266.66	40319.54
Student	694.66	85.17
Faculty	68.58	7.51
Building	67166.66	13523.26

Equation of the Regression

Dependant Variable: Cost

Independant Variable	Estim. Coeff.	Beta %	Errors	T-Test
Student	141.33	.29	34.32	4.11
Faculty	973.31	.20	529.12	1.83
Building	1.59	.32	.26	5.95
Constant	61510.5751			

Coeff. of Determination = .996209229
Coeff. of Correlation = .998102815
Linearity Test (F-Test) = 700.796272
Degrees of Freedom = 8
Total of Errors Squares = 2910.92345

Table of the Residuals

1	245600.00	244459.76	1140.23
2	278800.00	281403.82	2603.82-
3	290500.00	289977.05	522.94
4	331100.00	332484.69	1384.69-
5	341700.00	338137.98	3562.01
6	371100.00	366329.74	4770.25
7	363500.00	367743.06	4243.06-
8	367800.00	369156.38	1356.38-
9	368000.00	367476.41	523.58
10	349600.00	348918.76	681.23
11	346900.00	347396.13	496.13-
12	344600.00	345716.16	1116.16-

- One condition of discordance:

  $D_{A/B}$ = Maximum of discordant variances between evaluations of the actions for any one criterion, divided by maximum of variances between extreme evaluation possibilities.

  $C_{A/B}$ is "perfect" if equal to 1, $D_{A/B}$ is "fatal" if equal to 1.

The rule of outclassement is such:

according to : P : limit of concordance
Q : limit of discordance

if:

- $C_{A/B} \geqslant P$ and $D_{A/B} \leqslant Q$, then A outclasses B
- $C_{B/A} \geqslant P$ and $D_{B/A} \leqslant Q$, B outclasses A
- if both A outclasses B and B outclasses A, they are considered as equivalent;
- in any other case, there is indetermination.

Example:

The academic committee has to choose one new Masters program to open next year from among four projects (or variants)

ME : Moon Explorer
PD : Psychoanalysis for Dogs
IE : Industrial Ecologist
GI : Gallups Interpreter

The Committee defines six criteria:

1 - Scientific level
2 - Labor-market opportunities
3 - Faculty Staff capabilities
4 - Student demand
5 - Expected direct cost
6 - Possibilities of sponsored research which can be associated to the project

For each project, each criterion is rated in five classes:

1 - Excellent (E)
2 - Good (G)
3 - Neutral (N)
4 - Insufficient (I)
5 - Bad (B)

After surveys and estimates, the results are:

Project Criterion	ME	PD	IE	GI
1 - Scientific level	E	N	B	I
2 - Labor market opportunities	I	E	G	N
3 - Faculty staff capabilities	B	N	N	E
4 - Student demand	G	E	G	I
5 - Cost	I	G	E	N
6 - Research	E	N	I	G

The following weights translate the relative importance attached to each criterion.

1 - 20
2 - 30
3 - 10
4 - 50
5 - 40
6 - 40

Then a relation is given between the different classes of each criterion.

Criterion Class	1	2	3	4	5	6
E	20	40	20	30	20	40
G	15	20	18	25	15	30
N	10	10	15	15	10	15
I	5	0	8	5	0	5
B	0	0	5	0	0	0

So that the following rates are given to the projects.

Project Criterion	ME	PD	IE	GI
1 - Scientific level	20	10	0	5
2 - Labor market opportunities	0	40	20	10
3 - Faculty staff capabilities	5	15	15	20
4 - Student demand	25	30	25	5
5 - Cost	0	15	20	10
6 - Research	40	15	5	30

[Outcomes: Program written by Xuan Tung Bui (University of Freiburg, Switzerland)]

MULTICRITERIA DECISION: ELECTRE

Your Table of Evaluation of the Criteria

CRIT. No.	CL. 1	CL. 2	CL. 3	CL. 4	CL. 5
1	20	15	10	5	0
2	40	20	10	0	0
3	20	18	15	8	5
4	30	25	15	5	0
5	20	15	10	0	0
6	40	30	15	5	0

Your Table of Evaluation of the Variants

CRIT. No.	M E	P D	I E	G I
1	20	10	0	5
2	0	40	20	10
3	5	15	15	20
4	25	30	25	5
5	0	15	20	10
6	40	15	5	30

Your Weighting of the Criteria

Criterium 1 Weight: 20
Criterium 2 Weight: 30
Criterium 3 Weight: 10
Criterium 4 Weight: 50
Criterium 5 Weight: 40
Criterium 6 Weight: 40

RESULTS OF ELECTRE

Matrix of Concordance

	M E	P D	I E	G I
M E	-	31.	57.	57.
P D	68.	-	78.	73.
I E	68.	26.	-	63.
G I	42.	26.	36.	-

Matrix of Discordance

	M E	P D	I E	G I
M E	-	100	50	37.
P D	62.	-	12.	37.
I E	87.	50	-	62.
G I	50	75	50	-

Matrix of Outclassement

For Concordance = 1 and Discordance = 0

	M E	P D	I E	G I
M E	0	0	0	0
P D	0	0	0	0
I E	0	0	0	0
G I	0	0	0	0

Matrix of Outclassement

For Concordance = .68 and Discordance = .63

	M E	P D	I E	G I
M E	0	0	0	0
P D	1	0	1	1
I E	0	0	0	0
G I	0	0	0	0

Example 4

Retrenchment, quality of education, public opinion and catastrophe theory

For the relationship between Catastrophe Theory and administration of institutional research, see:

- Zeeman, E.C., A geometrical model of ideologies. In Cooke, K. and Renfrew, A.C. (Eds), Transformations : Mathematical approaches to culture change. London: Academic Press, 1979, pp. 463-479.
- Zeeman, E.C.: Catastrophe models in administration. AIR 20th Forum, 1980.
- Johnson, F.C.: Applications of catastrophe theory to institutional research. AIR 20th Forum, 1980.
- Cossu, C.: Financial attrition, fixity of variable costs,... and catastrophe theory - 2nd European AIR Forum, 1980.
- Cobb, L.: Stochastic differential equations for the social sciences. In Cobb, L. and Thrall R.M. (Eds): Mathematical frontiers of the social and policy sciences. Boulder: Westview Press and AAAS, 1980.

For statistical estimation for the cusp model, see:

- Cobb, L.: Estimation theory for the cusp catastrophe model. In 1980 Proceedings of the section on Survey Research Methods. Washington D.C.: American statistical Association, 1980, pp. 772-776.
- Cobb, L.: Parameter estimation for the cusp catastrophe model - Behavioral Science, vol. 26, 1981.

Example:

The department of management science of the University of Kon-Tiki Beach followed for years a policy of quality but, after some years of financial retrenchment, seems to have some difficulties in maintaining it.

Every year, it conducts two surveys:

- an internal survey to estimate (as objectively as possible) the intrinsic level of quality of its educational methods and procedures;
- an external survey among potential students, professionals and employers to measure the perception of this quality.

The following data are to be analysed:

Academic Year	Budget for education 1984 constant $	Intrinsic level of quality (/100)	Perception of quality (/100)
1966-67	2,000	25	10
1967-68	3,000	40	18
1968-69	4,000	45	20
1969-70	6,000	62	34
1970-71	8,000	80	60
1971-72	10,000	88	75
1972-73	12,000	92	88
1973-74	15,000	96	97
1974-75	16,000	96	97
1975-76	18,000	98	100
1976-77	20,000	99	100
1977-78	20,000	99	100
1978-79	19,000	80	95
1979-80	18,000	65	85
1980-81	18,000	65	85
1981-82	16,000	55	30
1982-83	15,000	50	20

[The programs used are those listed in Cobb (1981), adapted by Cossu.]

PROGRAM 1: Test of bimodality of dependant variables, as a necessary condition of relevance of cusp catastrophe theory

```
                 Case                          Value

                   1                             10
                   2                             18
                   3                             20
                   4                             34
                   5                             60
                   6                             75
                   7                             88
                   8                             97
                   9                             97
                  10                            100
                  11                            100
                  12                            100
                  13                             95
                  14                             85
                  15                             85
                  16                             30
                  17                             20

      Mean           =   65.5294118
      Standard Dev.  =   33.9049149

      Standardized Moments:

                   1                          -1.36959202E-10
                   2                             .999999998
                   3                          - .461758873
                   4                            1.4818942
                   5                           -1.32371288
                   6                            2.69225468

      Polynomial Coefficients:

                   1                           -3.91699785
                   2                          -11.1674582
                   3                             9.00390304
                   4                           11.0163669

      Cusp Density Parameters:

           Location      :                     56.2923506
           Scale         :                     84.1396984
           Asymmetry     :                       .23547572
           Bifurcation   :                      4.10367839
           Discriminant  :                     -2.54564401
```

PROGRAM 2: Statistical adjustment to the cusp function

```
The cusp model in standard form is:

0 = A+B*<Y-L>/S-<<Y-L>/S>↑3

A = A0+A1*X1+...+AK*XK    (Normal Factor

B = B0+B1*X1+...+BK*XK    (Splitting Factor


Standardized Factor Coefficients:

Index          Normal          Splitting
  0            - .997            -1.612
  1            15.827             4.59
  2            43.328            -7.462


Location          (L)  =   64.0141964
Scale             (S)  =   10.1821409
Goodness of Fit   (G)  =  387.430617
Number of Cases   (N)  =   17


Case     OBS-Y          Mode            Antimode         Mode
  1     + 10.000     + 10.069343
  2     + 18.000     + 17.548549
  3     + 20.000     + 20.341307
  4     + 34.000     + 32.831586
  5     + 60.000     + 63.898836
  6     + 75.000     + 81.498014
  7     + 88.000     + 87.857851
  8     + 97.000     + 94.117953
  9     + 97.000     + 95.559442
 10     +100.000     + 98.714539
 11     +100.000     +101.401986
 12     +100.000     +101.401986
 13     + 95.000     + 95.866683
 14     + 85.000     + 39.877710    + 68.904644    + 83.260188
 15     + 85.000     + 39.877710    + 68.904644    + 83.260188
 16     + 30.000     + 26.522194
 17     + 20.000     + 22.442262


Error Mean             =     -.152524358
Error Variance         =     5.85705224
Variance of Dep. Var.=  1149.54325
Cusp Pseudo R↑2        =      .994904887
R↑2 Due Linear Fit     =      .602386666
```

APPLYING ROBUST REGRESSION TECHNIQUES TO INSTITUTIONAL DATA

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and

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and
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Center for Statistics and Operational Research
Vrije Universiteit

Introduction

Regression is a general statistical technique through which one can analyze the relationship between a dependent or criterion variable and one or a set of independent or predictor variables.

The most important uses of the technique as a descriptive tool are:

(1) to find the best linear prediction equation and evaluate its prediction accuracy;

(2) to control for other confounding factors in order to evaluate the contribution of a specific variable; or set of variables;

(3) to find structural relations and provide explanations for seemingly complex multivariate relationships, such as is done in path analysis.

The general form of a linear regression model with k independent variables is:

$$Y_i = a^{\circ} + a_1 x_{i1} + \ldots\ldots a_k x_{ik} + e_i$$

where $i = 1 \ldots\ldots n$ and n represents the number of observations.

e_i is an error term and is usually assumed to be normally distributed with mean zero and standard deviation σ.

The a_i's are regression coefficients.

The purpose of regression analysis is to estimate the unknown regression coefficients, starting from the sample of n observations:

$$x_{i1} \ldots\ldots\ldots\ldots x_{ik},\ y_i$$

The most well-known and generally used technique for this is least squares (LS), due to Gauss, which determines the a_i- coefficients in such a way that the sum of squared residuals

$$\sum_{i=1}^{n} (y_i - y_i')^2$$

is minimized. This least squares criterion implies that any other values for a_i would yield a larger sum of squared residuals.

However, in this technique the presence of a single outlier can be sufficient to distort the least squares regression coefficients. The LS-line is too easily affected by these outliers because the sum of squared residuals increases very fast in the case of an outlying value of Y_i. Therefore, it is said that LS is not resistant because it cannot resist the effect of even a single outlier.

It is important to realize that outliers occur frequently in real data. Outlying observations can be present in a sample because of errors in recording observations, transcription or transmission errors, or they may be caused by an exceptional occurence in the investigated phenomenon. In the two-dimensional case it is quite easy to detect influential cases, just by plotting the observations. However, this visual tracing is not possible for more dimensions. So in practice one needs a procedure which is able to diminish the impact of outliers other than the common subjective deletion of observations.

There have been many proposals to improve on the resistance of LS. In 1887, Edgeworth proposed to replace the sum of squares by the sum of the absolute values, giving less weight to extreme observations. This so called least absolute values method is fairly insensitive to outliers in the Y-direction (called 'high residuals'), but still cannot cope with grossly aberrant values of X. The latter points are called 'leverage points' because one of them is sufficient to tilt the line.

A generalization of this method was introduced by Huber (1973), who proposed what is now called a Huber-type M-estimator. In this method, however, there is also no resistance against leverage points.

Therefore, general M-estimators were proposed by Mallows (1975) and Schweppe (see Hill, 1977). These methods were refined by Hampel (1978), Krasker (1980) and Krasker and Welsch (1982). All of these estimators were resistant up to a contamination level of 33.3% in the case of K=1.

Techniques that can resist up to 50% of outliers were developed by Siegel (1982) and Rousseeuw (1983). A breakdown point of 50% is indeed the best that can be achieved. For larger amounts of contamination it may be impossible to distinguish the 'good' from the 'bad' part of the observations.

The Least Median of Squares Regression Technique

Theoretical Background

In this paper we use an alternative method, namely the Least Median of Squares (LMS) regression technique, which was developed by Rousseeuw (1982), based on an idea of Hampel. As was explained before, the Least Square estimates of the regression coefficients correspond to:

$$\underset{a_j}{\text{minimize}} \quad \sum_{i=1}^{n} r_i^2$$

where the residuals r_i are given by the difference between the actual and the estimated y-values.

The LMS-method is defined as:

$$\underset{a_j}{\text{minimize}} \quad \underset{i}{\text{median}} \; r_i^2$$

It has been proven by Rousseeuw (1982) that this method has a break point at 50% which means that it can resist the effect of up to 50% of outliers. For this reason the LMS regression is called a 'robust' statistical procedure. The algorithm that is used can be summarized in the following way (see Leroy and Rousseeuw, 1984). Choose at random k+1 observations out of the n and solve the system of linear equations. This solution gives a direction:

$$(a_0^j \ , \ a_1^j \ , \ \ldots\ldots\ldots, \ a_k^j \ )$$

in a (k+1) dimensional space. Then evaluate the objective function. Repeat this procedure m times and retain that direction for which the objective function is minimal. The number of replications (m) is determined by requiring that the probability that at least one of the m subsamples is 'good' is at least 95%. A subsample is good if it consists of k good observations of the sample, which may contain (in the most extreme case) about 50% bad observations.

The resulting 'best' direction is handled as a preliminary solution. The standardized residuals resulting from this solution, which are obtained by dividing the residuals by a scale estimate for the LMS regression, are then used to assign a weight (w_i) to each observation. Points with marginal or zero weights can then be identified as outliers. Finally, these weights are used to calculate the corresponding reweighted LS regression coefficients.

In order to have an idea of the strength of the relationship between the independent and the dependent variables, the coefficient of determination (R^2) can be calculated. This coefficient measures the proportion of total variability explained by the regression equation. For the reweighted LS this coefficient is defined in the same way as for ordinary least squares, but all terms are multiplied by their weight w_i.

An Example of the Reweighted LS Regression

The following example illustrates the advantages of the least median of squares regression technique. For the following sample of ten (non-existent) universities we want to investigate the relationship between the number of students (X) and the number of academic staff (Y).

University	Students	Academic Staff
1	500	60
2	750	80
3	1,000	95
4	1,200	115
5	1,500	152
6	1,450	150
7	1,600	170
8	2,000	190
9	2,200	225
10	2,500	247

Figure 1. Scatterdiagram and regression lines: students (X) with academic staff (Y). No outliers

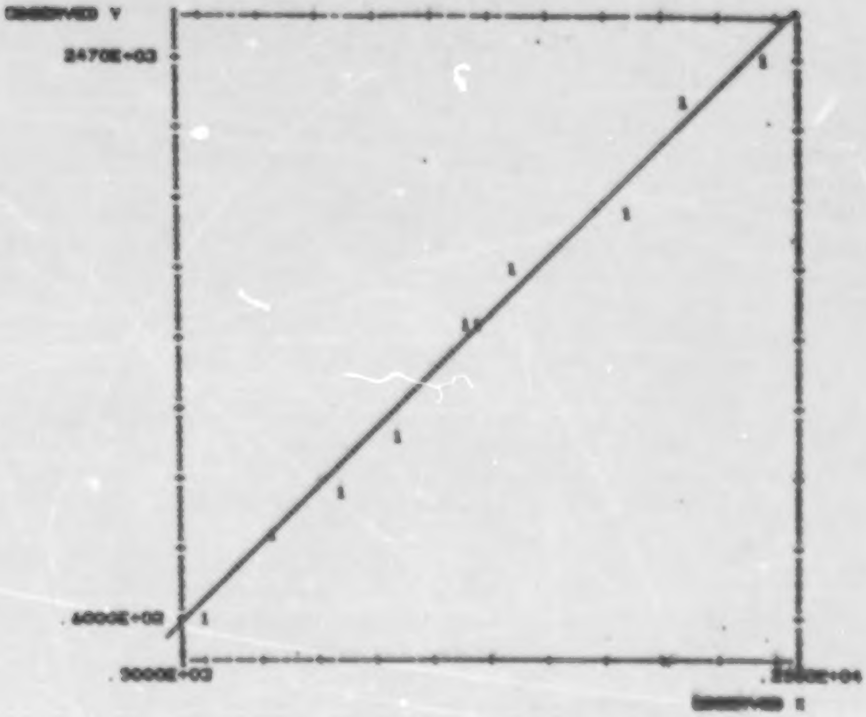
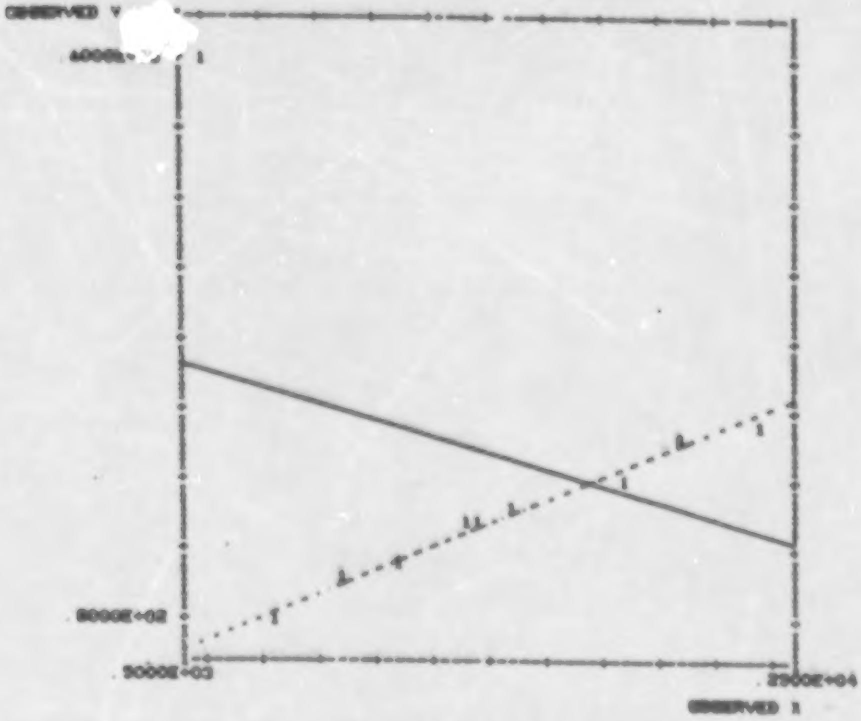


Figure 2. Scatterdiagram and regression lines: students (X) with academic staff (Y). With one outlier.



The scattergram, shown in Figure 1, tells us that there is a strong linear relationship between both variables. As one can see all ten observations lie on a straight line and it is clear that there are no outliers in the sample.

Applying the least squares regression technique gives the following regression line:

$$Y = .0964X + 6.67 \qquad (R^2 = .99)$$

This regression line fits the data very well, as indicated by the coefficient of determination which is nearly 1. The reweighted LS regression coefficients, resulting from LMS, are exactly the same as those obtained by using the ordinary Least Squares technique.

Let us suppose that one of the data was recorded incorrectly. Instead of 60 members of academic staff for the first university, we now have 600. The new scattergram is plotted in Figure 2. It is clear that the first observation (see the point, surrounded by a circle) is an outlier, which means that we are dealing with a contaminated sample. The classical LS regression gives a totally different equation as compared to the first case:

$$Y = -.0473X + 271.86 \qquad R^2 = .04$$

Now the slope is negative and the constant term has risen considerably. It is clear that both coefficients are influenced strongly by this outlying observation and therefore the regression line fits the other observations very badly (the coefficient of determination is nearly zero).

The reweighted LS line is given by the following equation:

$$Y = .0985X + 2.76 \qquad R^2 = .99$$

It is obvious that the robust method neglects the outlier and therefore, the regression coefficients do not change significantly. It is also interesting to note that it is not sufficient to examine the residuals resulting from the least squares technique because the outlier does not even possess the largest residual. The distortion has pushed the otherwise good observations away from the regression line, and this effect makes it difficult to detect the bad observations.

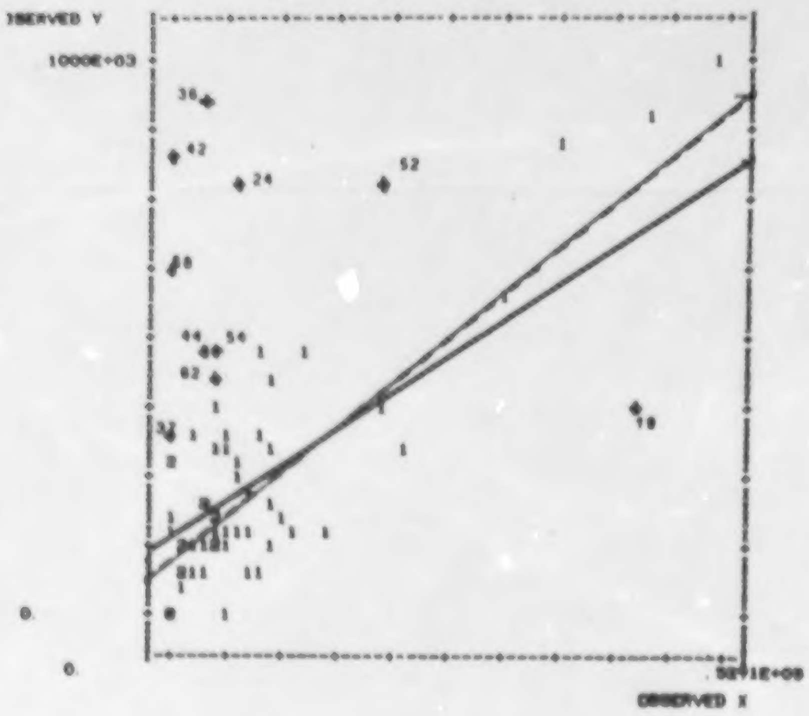
A Model for the Allocation of Non-Academic Staff

In 1980 we constructed a model for the allocation of the administrative and technical staff (in short "non-academic" staff) between the academic units (departments) of the Free University of Brussels (see Bingen and Siau, 1981 and Siau, 1984). More specifically, the requirements for administrative and technical personnel of the academic units, the ultimate producers of the outputs of a university, were analyzed and an attempt was made to relate these needs to a number of relevant output parameters, each of them describing the volume and the nature of the teaching and research production.

In the first phase of the analysis, the activities of the staff members were decomposed into significant components which were more or less obviously related to some basic variables pertaining to teaching and research. This generated the following classification of activities:

- support of teaching activities;
- support of research activities;
- administrative tasks.

Figure 3. Scattergram and regression lines: administrative support of teaching (Y) with STUTT (X).

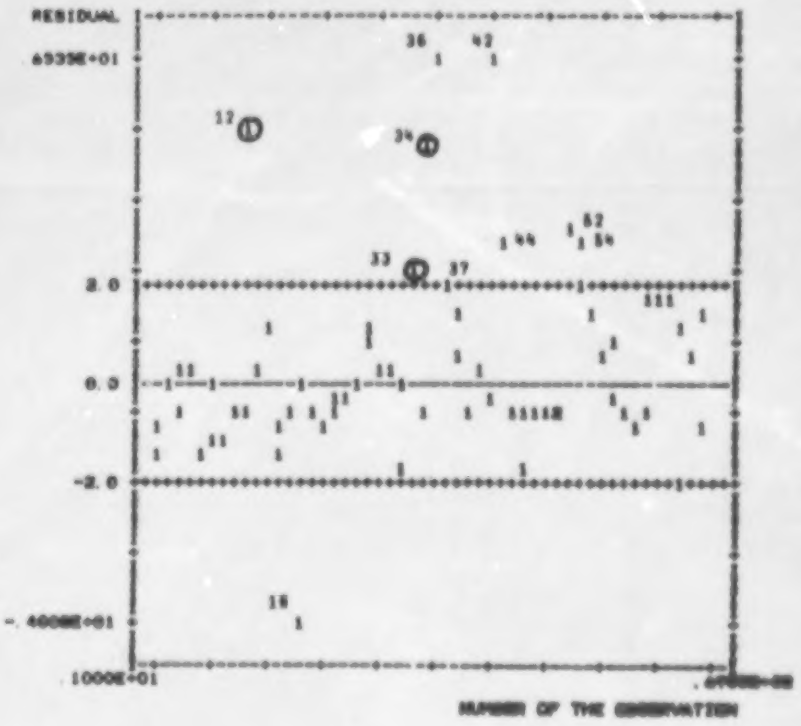


♦ = identified as outliers in Reweighted Least Squares.

----- RLS - Line

——— LS - Line

Figure 4. Residual plot of the Reweighted LS : administrative support of teaching.



⊙ = identified as outliers in LS and RLS.

All possible tasks were classified as one of the above categories. Each member of staff was asked to account for the time spent on each task category. Summing over all members of staff in this way, one gets for each academic unit the number of full-time-equivalent staff needed for each activity category. In a second step we tried to relate each piece to basic variables, describing the research and teaching programs of the academic units. These variables were fairly standard for teaching (e.g. "numbers of student-hours of exercises and practical laboratory work", number of students ...) As there existed at that moment no convincing measures for the research output, we were obliged to use input-based activity parameters, such as the "research time in FTE of man-years of academic staff" and "the value of specific categories of laboratory equipment" as variables for the research production.

We used the ordinary Least Squares method (LS) to find the appropriate regression relationships, which were kept linear for a number of reasons. As the dependent variables were only estimations of the time that was spent, it was to be expected that "outliers" would disturb the regressions. Moreover, it was generally known that some units were overstaffed and that others were understaffed. This was the result of a subjective and political resource allocation practice in the past. Due to this, the number of outliers in each regression was quite high and the values of the regression coefficients were influenced strongly by high residual and leverage points. As robust regression techniques were not developed to the phase of practical use at that time, the only way to avoid contamination was a subjective deletion of points.

Purpose and Methodology

In what follows we will give the regression results that we found using the ordinary least squares technique for each activity category. We will show the results before and after the deletion of the cases which were suspected to be outliers. In the Tables we will speak of LS1 and LS2 respectively. The results of both least squares regressions will then be compared with those obtained by using the reweighted LS regression technique, based on the Least Median of Squares.

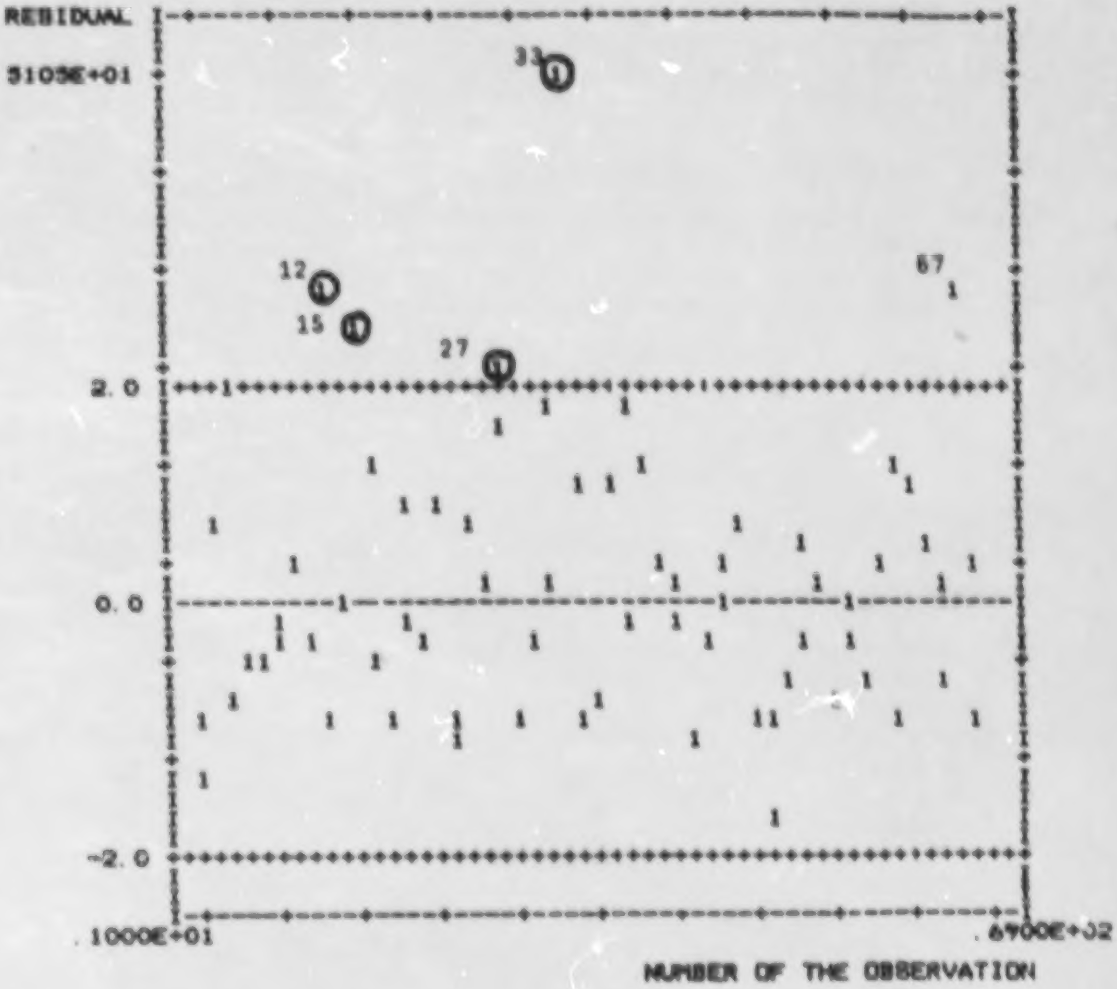
For the identification of the real outlying cases (the bad observations) a plot of residuals, corresponding to the reweighted LS-estimator, will be produced. In this residual plot a dotted line is drawn through zero and a horizontal band on the interval (-2,2) is marked. These lines will facilitate the interpretation of the results. Observations located in the neighbourhood of this zero line are best fitted by the model. If the residuals are normally distributed then one can expect that roughly 95% of the standardized residuals will lie within the limits of the horizontal band. So observations for which the standardized residuals are situated far from this confidence band can be identified as outlying. In this way we will be able to evaluate to what extent the previous deletion of cases, based on traditional LS residual analyses and on subjective criteria, corresponds to the objective deletion of observations resulting from LMS.

Results

Administrative Support of Teaching Activities

In a first regression run we related the number of clerical staff needed for the administrative support of teaching programs to the teaching load variable STUTT, representing the total number of student-hours of theo-

Figure 5 : Residual plot of the Reweighted LS : administrative support of research.



0 = Identified as outliers in LS and RLS.

retical and practical exercises for which an academic unit is responsible. A first plot of the scattergram (see Figure 3) indicated no strong relationship between both variables. This was confirmed by the results of a first LS regression run (see Table 1, regression LS1).

Table 1

Regression Results
Number of non-academic staff needed for
the administrative support of teaching activities

Variable	Regression	B	std. error	t
STUTT	LS1	$.130(10^{-4})$	$.022(10^{-4})$	5.85
	LS2	$.140(10^{-4})$	$.023(10^{-4})$	6.02
	RLS	$.166(10^{-4})$	$.013(10^{-4})$	13.18
Constant	LS1	.142	.030	4.67
	LS2	.116	.032	3.59
	RLS	.064	.017	3.85
R^2	LS1	.34	N	69
	LS2	.40		57
	RLS	.73		69

After a first examination of the residuals, we deleted the following 12 observation numbers: 1, 4, 12, 15, 27, 28, 32, 33, 34, 38, 39 and 51. A new LS-regression on the remaining 57 cases gave only a very slight improvement of the regression results, as is indicated in Table 1 (regression LS2).

The residual plot for the reweighted LS in Figure 4 demonstrates that only three of the 12 deleted observations can be considered as outliers. The other observations are located within the boundaries of the horizontal confidence band and can therefore not be considered as outlying cases. On the other hand, the residual plot reveals that other observations, which were not deleted in LS2, are located outside the confidence interval and must therefore be considered as outliers.

It is clear now that the deletion of cases performed in LS2 was far from being correct. Because of that the regression results did not improve significantly. Due to a much better identification of the outliers, the reweighted LS-method yields a regression line which fits the majority of the data in a much better way. This is demonstrated by the increase of the R^2 and of the t-values.

Administrative Support of Research Programs

In a first LS-regression run we have related the number of clerical staff to the number of FTE academic research staff (RESPE), which is assumed to be a good indicator for the research outputs. The resulting regression equation explained only very weakly the variance of the dependent variable, as was indicated by the coefficient of determination ($R^2 = .10$). A residual analysis indicated the units of the law faculty to be deviant from the other academic units. For nearly all of them the theoretical requirements, given by the regression equation, were higher than the actual numbers of staff. Therefore we introduced some sort of 'dummy' variable (RESPER) with the same value as for RESPE for the units of the law faculty and a zero value for all the other observations.

The inclusion of this variable in the equation improved the prediction power only very little (see R^2 in LS1 of Table 2). Nevertheless, the higher staff requirements for the law-units were confirmed by a statistically significant regression coefficient for this new variable. As in the foregoing analysis we deleted the observations (the same 12) which we suspected to be outlying cases. A least squares regression on this smaller sample gave much better results (see regression LS2 of Table 2).

Finally, we applied the reweighted regression technique on the complete set of data. One can see from Figure 5 that only four of the 12 deleted cases are identified as outliers. The figure also indicates that, except for observation 67, there were no other outlying cases. As the R^2 value is worse now (see Table 2), it is clear that in the LS2 regression we deleted a lot of 'good' observations, although these observations had a negative influence on the strength of the relationship.

Table 2

Regression Results
Number of non-academic staff needed for
the administrative support of research activities

Variable	Regression	B	std. error	t
RESPE	LS1	.0239	.0080	2.99
	LS2	.0361	.0056	6.40
	RLS	.0245	.0059	4.14
RESPER	LS1	.0847	.0314	2.69
	LS2	.1006	.0210	4.81
	RLS	.1031	.0257	4.01
Constant	LS1	.1898	.0366	5.18
	LS2	.1020	.0270	3.81
	RLS	.1521	.0273	5.58

		R^2		N
R^2	LS1	.19	N	69
	LS2	.53		57
	RLS	.33		69

Technical Support of Experimental Teaching Activities

In the 1980 analysis we found that the number of technical staff required for teaching activities is mainly determined by the following two teaching variables: STUL (which represents the teaching load due to practical laboratory exercises, expressed in student-hours) and THES (representing the number of last-year students writing an experimental junior thesis).

Table 3

Regression Results
Number of non-academic staff needed for
the technical support of teaching activities

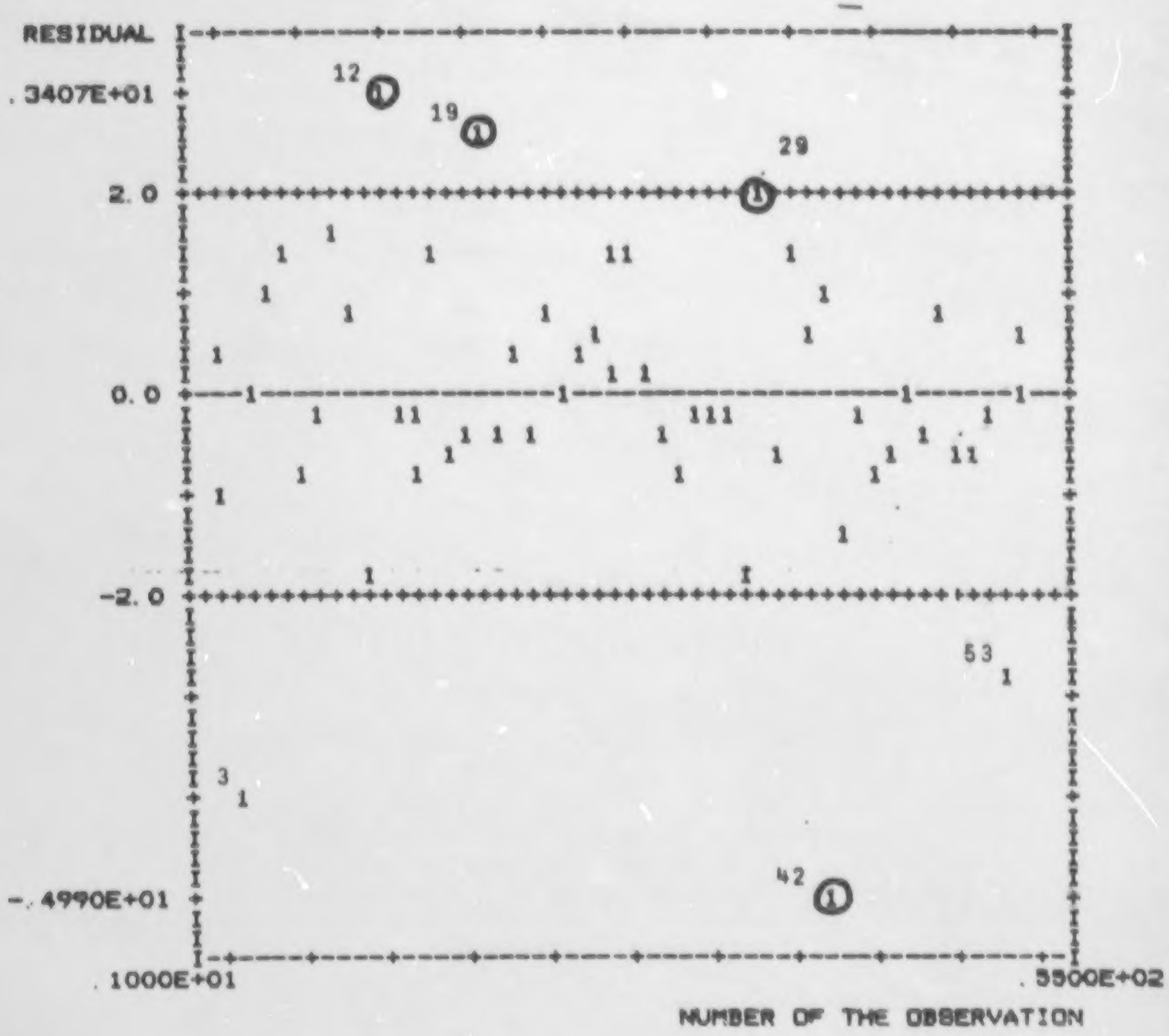
Variable	Regression	B	std. error	t
STUL	LS1	$4.60(10^{-5})$	$.721(10^{-5})$	6.35
	RLS	$7.49(10^{-5})$	$.790(10^{-5})$	9.51
THES	LS1	.0946	.0182	5.19
	RLS	.0936	.0133	7.01
Constant	LS1	.1920	.0890	2.38
	RLS	.0590	0580	1.01
R^2	LS1	.56	N	55
	RLS	.75		55

A thorough analysis of the LS-residuals indicated that the regression equation overestimated the value of Y for observation 42 and underestimated it for observations 12, 19 and 29. Although the conclusion might be that these observations were outlying cases, we did not remove any observations from the sample. Figure 6 tells us now that observations 12, 19, 29 and 42 were indeed outliers. Moreover, it appears that observations 3 and 53 are also outlying cases. All of the outlying data are given zero or marginal weights to calculate the reweighted LS coefficients (see Table 3). When we compare the results of both regressions we can see that the coefficient of determination has risen considerably, which illustrates that the robust regression fits the 'good' observations much better. The regression coefficient for the teaching variable STUL has changed significantly whereas the coefficient for the other teaching variable is not statistically different from the LS-regression.

Technical Support for Experimental Research Activities

We related the number of technical staff required for the support of research activities to the number of FTE research staff (RESPE) and the variable LABEQ, which represents the total value of the scientific equipment stock. For the first variable, we made a distinction between two categories of academic staff; we will call them RESP12 and RESP22. A residual analysis indicated the academic units of the natural science discipline to be deviant from the other experimental units. For the majority of these units the theoretical requirements, given by the LS regression equation, were higher than

Figure 6. Residual plot of the Reweighted LS : technical support of teaching.



0 = identified as outliers in LS and RLS.

the actual requirements. For this reason a special variable was introduced (LABEQα), with the same value as for LABEQ for the natural science units and a zero value for all the other observations.

Before deletion of the outlying observations, the least squares regression technique yielded the results in Table 4 (see LS1). The regression coefficient for RESP12 was negative and not statistically different from zero. Contrary to our expectations, the coefficient for the new variable LABEQα was positive. As these results were not very satisfactory, we deleted the observations which we suspected to be outlying cases, observations 18, 20 and 37. The second observation was a very special one because the values of the majority of the independent variables were very high and because the unit was involved in natural science education and research. A least squares regression on this smaller sample yielded more acceptable coefficients (see LS2 of Table 4).

Table 4

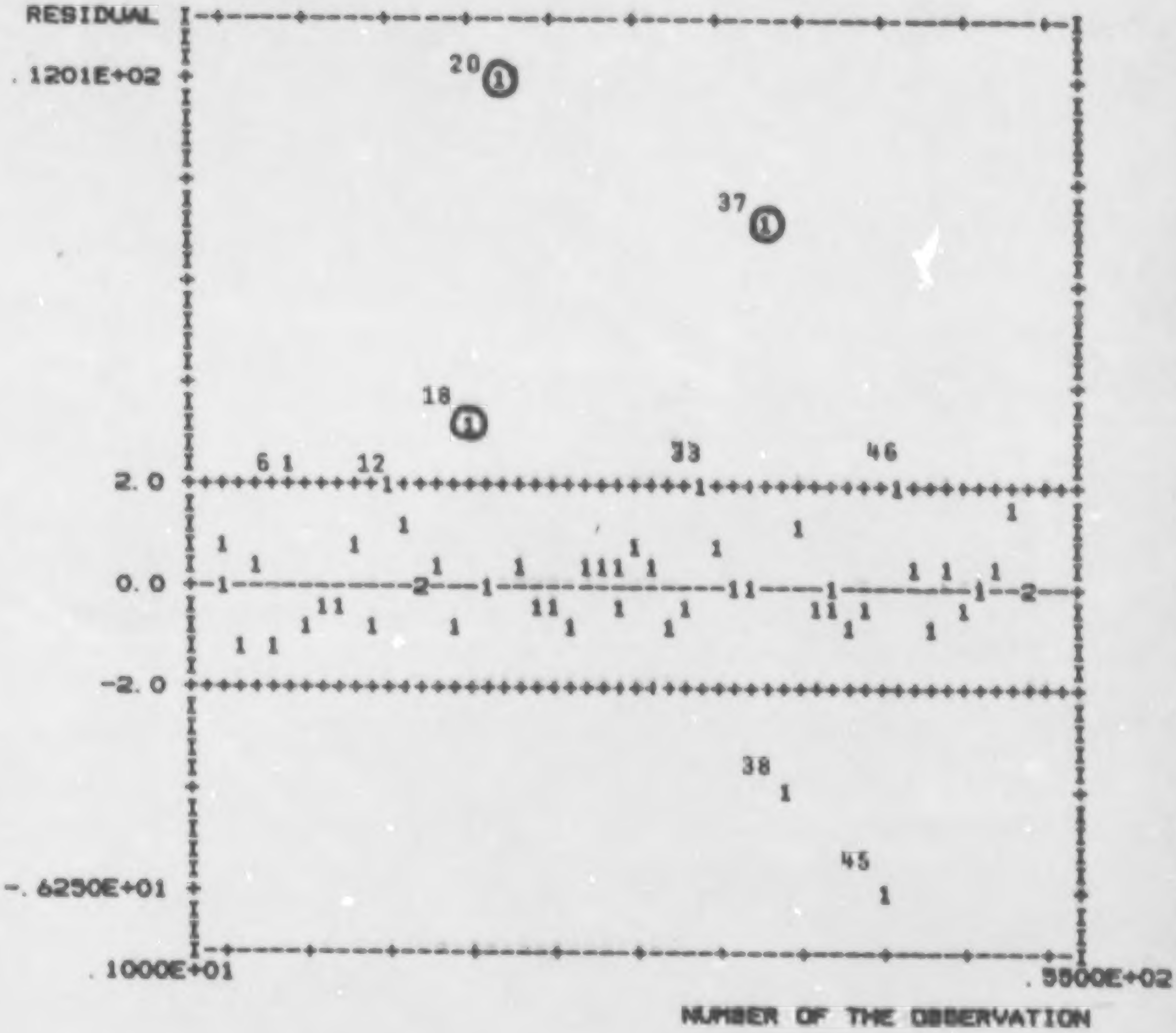
Regression Results
Number of non-academic staff needed for
the technical support of research activities

Variable	Regression	B	std. error	t
RESP12	LS1	-.0237	.1102	-.21
	LS2	.1167	.0729	1.60
	RLS	.1004	.0567	1.77
RESP22	LS1	.7079	.1718	4.12
	LS2	.4991	.1164	4.29
	RLS	.4155	.0933	4.45
LABEQ	LS1	$.7325(10^{-7})$	$.2292(10^{-7})$	3.20
	LS2	$.7329(10^{-7})$	$.1453(10^{-7})$	5.04
	RLS	$1.5867(10^{-7})$	$.0245(10^{-7})$	6.47
LABEQα	LS1	$.8425(10^{-7})$	$.3737(10^{-7})$	2.25
	LS2	$-1.0169(10^{-7})$	$.4485(10^{-7})$	-2.27
	RLS	$-1.4694(10^{-7})$	$.3683(10^{-7})$	-3.99
Constant	LS1	1.057	.331	3.19
	LS2	.872	.215	4.05
	RLS	.634	.176	3.59

R^2	LS1	.60	N	55
	LS2	.61		52
	RLS	.68		55

Finally we applied the reweighted regression technique on the complete set of data. One can see from Figure 7 that observations 20 and 37 as well as observation 18 are outliers. The first regression was badly influenced by the leverage point number 20, which was undoubtedly the most unusual observation. It is also interesting to note that observation 45 and, to a

Figure 7. Residual plot of the Reweighted LS: technical support of research.



0 = Identified as outliers in LS and RLS.

lesser extent, observation 38 are outlying cases, whereas in the LS-regression they seemed to be normal. Considering the increase of the coefficient of determination, one can see that the reweighted LS-regression technique provides here again a better explanation for the majority of the data. The significance of all coefficients is considerably higher, especially for the equipment variables.

Conclusions

Outlying observations are a well known phenomenon in regression analyses that deal with social science data in general and institutional data in particular. This paper demonstrates that the regression results, based on the traditional Least Squares method, can be thoroughly distorted by the presence of one or more outlying observations. The bivariate case (see for example Table 1) shows that the Reweighted Least Squares method, based on the Least Median of squares, is resistant against a large amount of contamination.

In the bivariate case it is not too difficult to detect the outlier by making a simple plot of the observations. In the multivariate case, however, such a plot is not possible and therefore it becomes very difficult to identify the aberrant cases. The residual plot of the reweighted LS seems to be an efficient tool for the identification of the "real" outlying cases. Most of the observations that were identified as aberrant in the traditional LS residual analysis or that were removed from the sample on subjective grounds did not appear as such when plotting the residuals given by RLS. Moreover, observations which were supposed to be "good" appeared to be "bad" observations in the RLS method.

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APPLYING STRATEGIC PLANNING IN ACADEMIC DEPARTMENTS: TAKING CHARGE OF CHANGE

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Introduction

The academic department represents the raison d'être of organizational units within our colleges and universities. It is the organizational unit in which students receive their instruction and advising. It is the unit students are linked to as majors and, therefore, receive much of their early discipline- and profession-related knowledge and socialization skills. It is the unit graduates of the institution generally most closely relate to since much of their knowledge base and intellectual and professional values were shaped by the faculty and fellow students with whom they associated during their degree program experience.

The academic department is also the unit that faculty call "home" since it is where they spend the majority of their time working with students and colleagues in scholarly- and program-related pursuits. It is the primary unit the institution relies on to generate new research and development ideas. It is also the unit the outside public (e.g., businesses, government agencies, and social service groups) often contact to gain direct assistance for dealing with various educational, technical, social, economic, and political problems. In essence, the academic department is recognized as the unit that provides most of the intellectual capital for the institution.

While academic departments represent the core organizational unit of our colleges and universities, today they are faced with an array of external and internal issues/problems which potentially threaten their ability to function effectively and to achieve their basic missions. Externally, for example, most, if not all, departments have begun to recognize the increasing competition for limited resources (i.e., students, facilities, budget, and research monies), both from within and outside the institution. Most are also trying to determine how the new information technology explosion will impact the instructional, research, and administrative functioning of the department and what short- and long-range actions should be taken in these regards. Within the institution, many are becoming increasingly concerned about the extent to which the academic dean and other institution-wide administrators value the department and its programs, and how these individuals see the department relating to the central goals and priorities of the institution, especially as dollars and other resources become more limited.

Internally several recuring issues/problems tend to hamper effective functioning and mission accomplishment. First, there often is a lack of the "big picture" on the part of the faculty with respect to understanding the relationship of the department's overall mission, its internal strengths and weaknesses, and its external environment. Secondly, the ability to translate this understanding into short- and long-range directions and priorities represents a problem to most. This situation is often due in part to the difficulty faculty sometimes have in reaching consensus on issues and priorities. This may be an outgrowth of faculty promotion, tenure, and salary decision criteria which reward individual performance but not the collective performance of the department. It may be due to the loyalties of faculty to their profession and other external groups, as well as incentives for pursuing entrepreneurial activities. Finally, as Breen (1984) points out from her study of planning in academic departments, many faculty simply are not all that interested in planning. Often this attitude is compounded by the fact that a long-range planning process has been mandated by the institution's central administration and the process has become viewed by the faculty as "compliance reporting".

In short, academic departments and, in particular, department chairpersons are faced with four broad issues. First, how do they go about the task of monitoring and adapting to a complex and rapidly changing environment? Second, what steps can they take to maintain quality and improve productivity in a time of shrinking resources? Third, what procedures can be implemented that will effectively organize and motivate faculty and staff to acquire the so-called "big picture" and engage in a process that will foster creative problem-solving and consensual decision-making with respect to departmental direction and priorities? Finally, what actions can be taken that will reaffirm a sense of control over the department's destiny.

Departments, in dealing with this situation, must recognize that while they are subunits of a larger system, i.e., the institution, they are dynamic and complex organizations in their own right. That is, each department constitutes "an open social organization described by its relevant environment and inputs; its internal component units, processes, and structures; and its functional outcomes" (Peterson, 1981, p. 26). Given this perspective, an academic department must act like any other organization by working to understand:

(1) what it wants to be;

(2) what is possible for the department in view of various opportunities and constraints posed by trends, competitors, organized groups outside the institution (e.g., professional associations, the public schools, and local, state, and federal government agencies) and individuals and groups within the institution but outside the boundaries of the department (e.g., the dean, central administration, and other departments that compete for limited institutional resources); and,

(3) what can and cannot be done given the personality of the department and its internal abilities, i.e., its strengths and weaknesses.

To be more specific, every department, like every organization, must strive to resolve the following series of five basic questions which have been posed by Hollowood (1979):

> All academic departments must resolve:
>
> - What is the basic purpose or thrust of the department? What is the range of opportunities facing the department in the external environment? How do college-wide policies and planning assumptions impact department goals, directions, and priorities?
>
> - What is the internal posture of the department? What capability does the department have to serve its external opportunities, public and conditions? How can the department achieve internal harmony in the face of often competing external goals?
>
> - What is the value system of the department? What are its ambitions? Regardless of the external conditions and the internal

posture, for what behavior will a department reward or punish its member ? What is its personality?

- Considering external conditions, internal conditions, and values, what is the department's statement of mission, role and scope?
- How does a department make its statement of mission, role and scope operational? How does it establish its "working" purposes, priorities and assumptions?

How might an academic department go about the task of answering these basic questions? Is there a process that might motivate and enhance the faculty's ability not only to understand how the department relates to its external environment, but to build consensus on the overall purposes, directions, and priorities the department should pursue? Finally, what might a department do to become more active in its planning efforts and take charge of its rapidly changing environment? The purpose of the remainder of this paper is to discuss why strategic planning is a process academic departments can use to deal with these issues and to describe a five-step procedure the author has used in several institutions to implement strategic planning at the department level.

The Concept of Departmental Strategic Planning

Strategic planning is a process which is being used increasingly by top-level administrators in our nation's colleges and universities to answer the types of basic questions posed above as they relate to the institution as a whole. However, it is also a process that can be implemented by academic departments to answer these same basic questions. This approach to planning, which has been widely referenced in the recent higher education management literature (for example see the writings of Cope, 1978; Hollowood, 1981; Peterson, 1980; Kotler and Murphy, 1981; and, most recently, Keller, 1983), is different from other forms of departmental planning (e.g., curriculum planning, facilities planning, long-range planning, and budget planning) in that it is in actuality a decision-making process or way of thinking that encourages the department chair and his/her faculty:

(1) to consciously and continuously examine the department's external environment;

(2) to relate the results of this examination to the basic mission, values, and internal conditions of the department; and,

(3) to decide on the strategies (i.e., the broad goals, thrusts and priorities) to be pursued in both the short- and long-range future.

To paraphrase Keller, who discussed the nature and characteristics of strategic planning from an institution-wide perspective in his highly popular book, Academic Strategy (1983), strategic planning when applied at the academic department level can be distinguished in the following ways:

1. The strategic decision-making of the department and its faculty leaders is active rather than passive about the department's position in history (its birth, growth and its will to survive).
2. The department's strategic planning looks outward and is focused on keeping in step with the changing environment.
3. The department's strategic planning is competitive, recognizing

that the department is subject to market conditions and to increasingly strong competition.

4. The department's strategic planning efforts concentrate on decisions, not on documented plans, analyses, forecasts and goals.

5. The department's strategic decision-making is a blend of rational and economic analysis, political maneuvering and psychological interplay.

6. Departmental strategic planning concentrates on the fate of the department and its programs above everything else. That is, it places the long-term vitality and excellence of the department first.

In many ways, strategic planning is a decision-making process that all departments, institutions, and even individuals practice whether they know it or not. That is, they attempt to make decisions about the general strategies they wish to follow to reach their goals (usually unstated) based on some general ideas about certain events and forces in their external environment and on some understanding of their own abilities. The strategic planning process being suggested for departments, however, is a process that calls for a conscious and continuing analysis of external and internal conditions and the use of this analysis to set departmental strategy relative to program direction, faculty, and staff development, departmental management improvement, facilities and equipment improvement, public relations, student recruitment, and so on. A further advantage of this process is that it encourages a department to be aggressive in charting its own strategic direction and in influencing its external environment. It can be implemented even if there is no institution-wide strategic planning process. If there is such an institution-wide process existing or if the institution requires some form of long-range planning (e.g., a rolling five-year long-range planning and budgeting process), such processes need not dictate how the department should plan. Rather if the department is engaged in effective strategic planning, it can remain in control of charting its short- and long-term direction and easily reply to institution-wide demands for the department's long-range plan and for justification of budget requests.

A Five-Step Departmental Strategic Planning Process

As an academic department prepares for the actual development of strategy, some framework or procedure is needed to guide the individuals involved. As noted earlier, the author has had the opportunity to work with a number of departments in several different types of institutions: a two-year community college, a four-year college, and a research university. Based on these experiences, a five-step departmental strategic planning process has been developed:

Step 1 - Re-examine the basic goals and values of the department and its programs.

The purpose of this step is to have those involved in the strategic planning process reassess the primary goals (both stated and unstated) of the department and its progams, the role it plays within the institution, and the scope of its activities. The persons involved are also asked to consider the various groups served by the department.

Step 2 - Determine the opportunities, constraints, and trends impacting the department and its programs.

The purpose of this step is to force the participants to look outside the department and examine the individuals, groups, competitors, trends, and other forces in the external environment impacting its past, current, and future performance. In this step, the department might consider the following factors in terms of the opportunities and/or constraints they pose for the department:

- Students (current, prospective, and former)
- Institutional administrators (dean, provost, president)
- Other academic departments in the institution
- Other offices in the institution with which the department interacts (student affairs, admissions, financial aid)
- Demographic trends
- Enrollment trends
- Financial health of the institution
- Economic trends
- Political and social trends
- Technological advancements
- Accrediting bodies
- Governmental agencies
- Funders

Step 3 - Assess internal condition of the department and its programs.

This step is intended to help understand the internal climate of the department as it functions within the institution. Specific attention is given to the following areas:

- Enrollment
- Instructional programs
- Faculty
- Instructional resources
- Space and equipment
- Admissions and counselling
- Academic progress of program majors
- Student aid
- Departmental budget
- Departmental administration

Generally, it has been found that the development of a set of questions pertaining to each of these areas has been a useful technique for getting faculty to examine the department's status. The set of questions requires both quantitative and qualitative data to be gathered. In fact, in this step and the other steps requiring data, approximately 85 to 90 percent of the data are qualitative in nature. Also, the Academic Department questionnaire, developed by Parekh (1977) in his Long-Range Planning Kit for institutions, is a useful tool in this step.

Step 4 - Identify the major strengths and weaknesses of the department and its programs.

This step is intended to help the department determine those attributes that make it distinct and unique within the institution. Given the previous steps and a thorough review of previous annual reports, self-studies, and other departmental evaluations, this step asks the participants to examine realistically the department's strengths and weaknesses with respect to the quality of its programs, faculty, and students, its services to the academic community and other external publics, and its overall image and goodwill.

Step 5 - Formulate strategic plans for the department and its programs.

Up to this point, attention has been given to understanding the basic planning parameters for the department, i.e., understanding the basic mission, role and scope of the department, internal and external conditions that influence the department's functioning, and key assumptions about the future. Given this background, this step requires attention to be directed to establishing the broad goals, directions and priorities to be pursued by the department in both the long- and short-run. Here the participants are asked to make strategic decisions about the following:

- Program direction priorities
- Student recruitment, admission, and advising priorities
- Space and equipment priorities
- Faculty/staff development priorities
- Management improvement priorities
- Public relations priorities

Implementation of this five-step departmental strategic planning process has resulted in several positive outcomes. First, faculty have come to view it as a very flexible and nonthreatening process. Secondly, it has allowed faculty to get a sense of the "big picture", i.e., the understanding of the relationship of the department to its external environment. Thirdly, it has provided an excellent vehicle for enchancing faculty dialogue about critical issues and priorities. Fourth, it provides an excellent orientation for new faculty about the history of the department and the factors influencing its performance. Finally and maybe most important, it has given faculty a feeling that they can influence what happens to them and their department and, therefore, there is a renewed feeling of having control over their own destiny.

Final Comments

This paper has argued that strategic planning is a decision-making process that has utility for academic departments as well as the institution as a whole. It has pointed out that the process will help departments better understand what they want to be, what might be possible, and what can and cannot be done by the department given its strengths and weaknesses. In many ways it suggests that strategic planning is a process that operationalizes what Louis Pondy (1983) has referred to as a "union of rationality and intuition in management thought".

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THE IMPACT OF INSTITUTIONAL RESEARCH ON EDUCATIONAL DECISIONS
THREE EXAMPLES WITH APPLICATIONS

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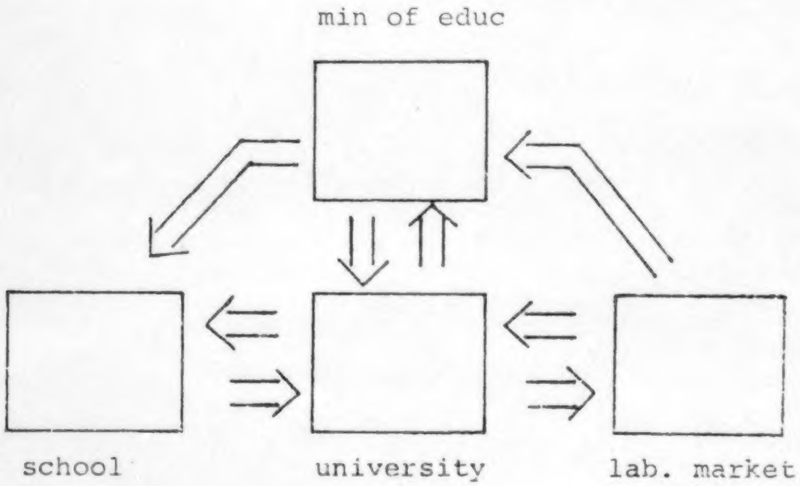
Introduction

Decisions connected to university education are taken by various persons/groups/bodies depending on the actual matters. The actors and interactions form the following pattern when external relations are under consideration:

Figure 1

A dynamical frame for university management



The flow of people (students/candidates) is contained in the horizontal flow. Financial and other relations with the Ministry of Education are vertical interactions. The feedback into education and research comes from all corners.

As well as about people, information of all kinds is a main component of the interaction; in this context especially quantified information produced by institutional research. Let a few examples illustrate some of the key points in external relations -- of course there are a lot of others which could also be listed.

The university (teacher/administrator/responsible body) is amongst other things concerned about:

- the students' behavior in the educational system (passing examinations);

- the labour market relations for the candidates;
- the recruitment from the school of the new generation of scientists;
- educational parameters used by the Ministry of Education in managing the university sector quantitatively, qualitatively, and economically.

The student at school wants to know:

- what the university will do to him in "black box terms"; i.e. pass rates, average times of study;
- labour market profiles.

The staff-responsible persons in the labour market want -- idealistically formulated -- to know the general skills of the candidates. The realistic picture is provided by:

- individual research-based knowledge between companies, scientific groups, and skilled candidates;
- examples from a broad spectrum of disciplines.

It is our experience that there is a gap between the single employer/company and the labour market organizations of the same type as there is between the single department and the Ministry.

The Ministry of Education is mostly concerned about the economy, but also about the input/output of the universities; i.e. research and education. This is not the place to comment on the Danish managing and resource allocation system based on certain performance indicators, but among the central factors are:

- the number of passed examinations;
- the yearly number of new students;
- the pass rates;
- the employment rates, actual and projected.

I will comment on three examples of institutional research done in order to produce quantitative measurements of some of the factors listed above. The analyses are:

A. The flow of university students;

B. The employment development;

C. The un-employment as 'well-box'.

For each example I will comment on the background, the methods and the results. The applications in the above described pattern are obvious. Decision makers are provided with background, and negotiations can take place utilizing this substantially. Derived from the old phrase "knowledge is power" you will see that decentralized institutional research is a twin sister to decentralized autonomy.

All methods and results are original. They have been published since 1977. Some of them have been used by the Ministry of Education with reference.

A - The Flow of University Students

The course for the Danish degree "kandidateksamen" (candidate = M.Sc.) is normed to five years. The structure of the first three to four years of study consists of separate discipline modules with separate examinations, with approximately three per semester. The last period is individually organized with one final examination and a thesis. The combination of modules is regulated by purely qualitative rules.

There is a pass rate of approximately 40%, as for almost all other continental university studies, and an average time of study of approximately 7.5 years.

The classical flow statistic is done by measuring the relevant factors for the candidates when they are obtaining their final degree after seven to ten years of study. But this is a statistic of the past and does not tell the decision-makers anything about the actual situation and its possible trends. And it doesn't tell anything about the drop-outs.

The three main ideas of the new flow statistics are:

1) Cohorts -- Definition of beginners each year divided into students who have just passed their entry qualification examination and other students. Such cohorts are formed for each year.

2) Full-time-equivalent -- Quantification of each module expressing its full-time-equivalent of the normed program.

3) Levels -- Definition of adequate levels in the normed program so that a given cohort can be divided into groups expressing the position in the course.

On the basis of these three concepts you can follow the development of each cohort and different cohorts can be compared. The results can be displayed by tables and graphs. Furthermore, they can be measured and tested statistically.

In Figure 2 the situation for the cohort of 1976 beginners in the exact sciences at Aarhus University is shown.

The curves describe semester by semester:

- from the top: the number of students still to be matriculated
- from the botton: the number of students who have passed a given level. The increasing levels are described by "1 module", "1 year", "2 year", "3 year", "final degree".

Statistics have shown that the 1976 cohort fits the shape of the other cohorts.

Pass-rates - From the general knowledge of the behavior of the students it is known that a person who passes all the examinations connected to the normed program for the first two years will obtain the final degree. In Figure 2 this is represented by the horizontal asymptote showing that approx-

Figure 2

1976 students in exact sciences

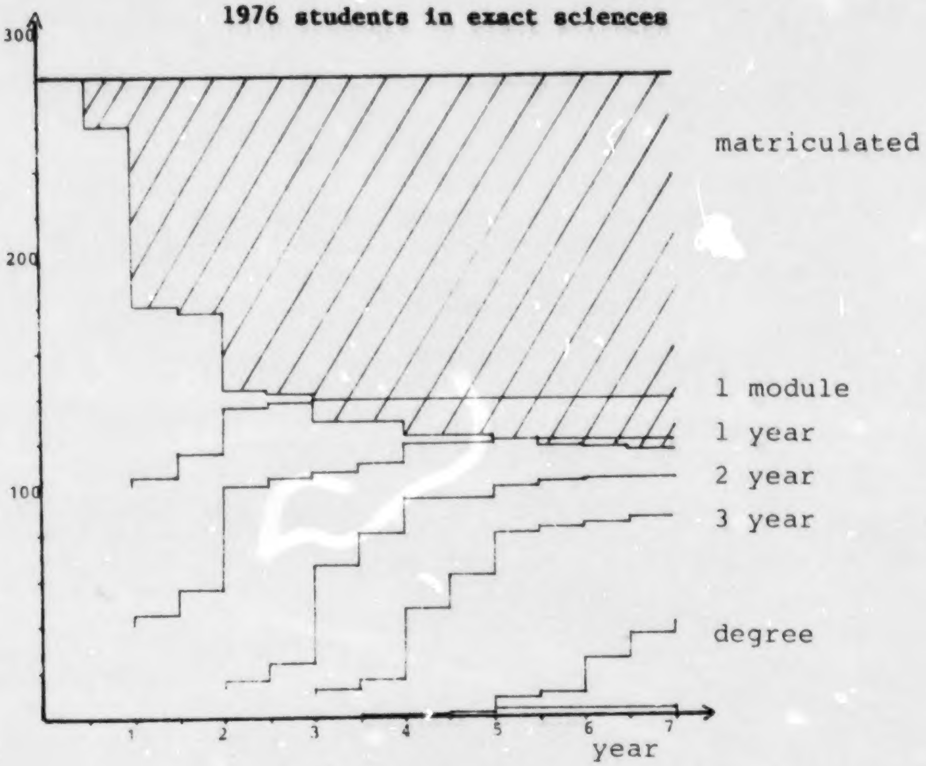
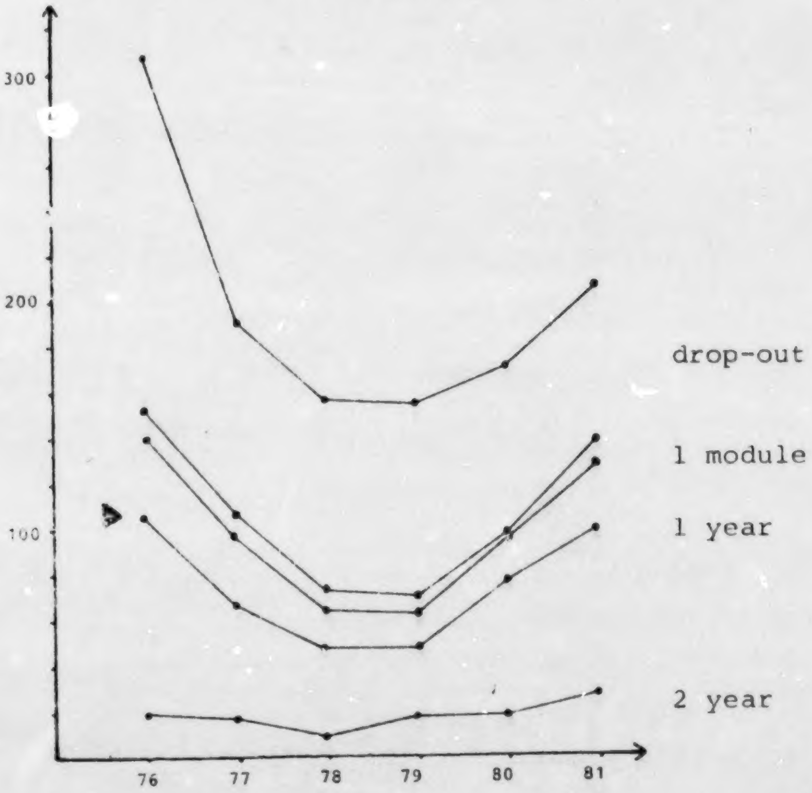


Figure 3.a

Comparison between cohorts after two years of study
Absolute



imately 102-103 of the total cohort (= 282) will pass, for a total of 36%.

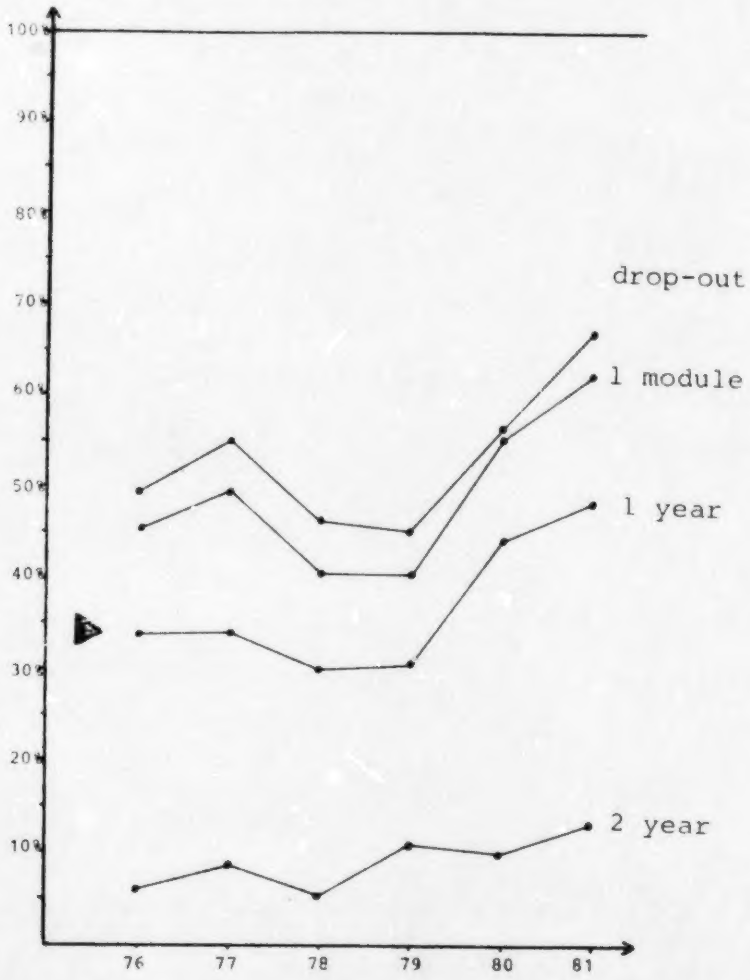
Average time - From Figure 2 it is possible to calculate the average time for reaching a given level or passing between two levels. The enclosed areas between the corresponding step-curves can be measured by numerical integration.

Prognoses - It can be seen that the number of students who pass at least one examination at the end of the first year and the number of students who have passed the normed one-year program after two years of study predicts the number of final degrees several years later. This result is confirmed by other cohorts. It is also valuable for individuals within a 10% tolerance.

Trends - If several cohorts are compared after two (or one) years of study it is possible to see if there are developments in the students' behavior. Figure 3.a contains the situation after two years in absolute numbers; Figure 3.b is the relative version. The estimate of the pass rate is marked by a dot. It is obvious that this information has a high value when the studies are evaluated inside and outside the university.

Figure 3.b

Comparison between cohorts after two years of study
Relative



Drop-outs - For the drop-outs we still have to measure the average length of the period before they decide to stop. Figure 2 shows that the drop-out takes place in the very beginning of the course. We have three types of data which provide information on the number of students.

α : the number matriculated;

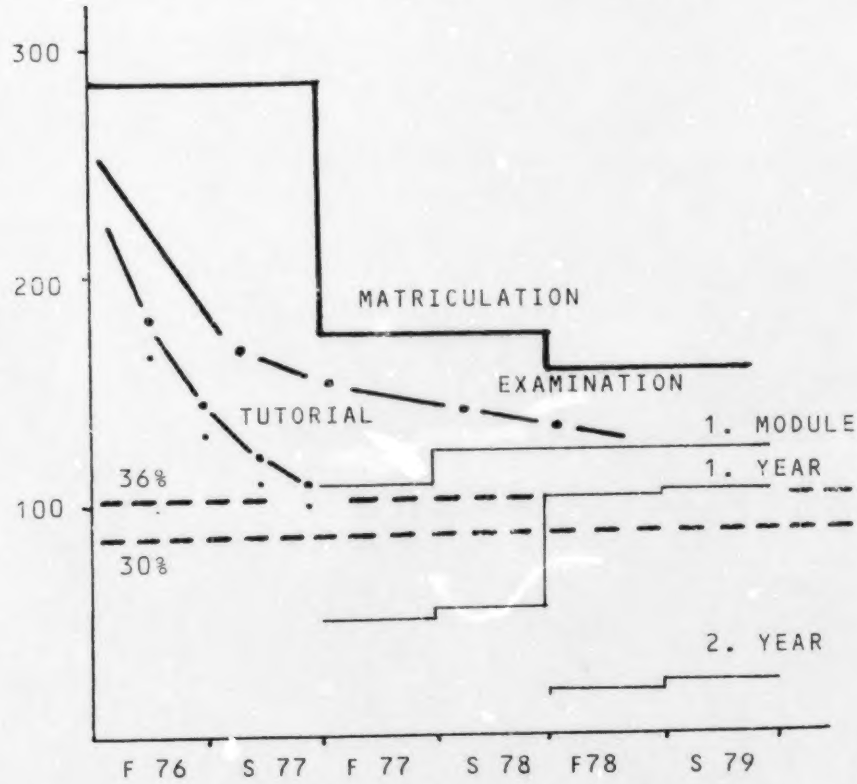
β : the number signed up for examination;

γ : the number cf participants in tutorials.

If these data are placed in Figure 2 we get Figure 4.

Figure 4

1976 students and the time for drop-out



The average time of study for that group is again calculated by numerical integration. It is obvious that the result depends on the drop-out rate.

At least two conditions have to be mentioned here.

Method-dependence - There is a factor on the order of 5-6 between the results depending on the chosen method. For classical statistical purposes, such as information to the Ministry of Education, matriculation data are used. I am not sure that possible users of such data are aware of the limited value of these data if the resource-consumption of the drop-outs is under debate.

Figure 5

Drop-outs, average time before stopping

Data source / Drop-out rate	64%	70%
Matriculation	1.7 y	1.8 y
Sign-up for examination	0.9 y	1.1 y
Participants in tutorials	0.3 y	0.4 y

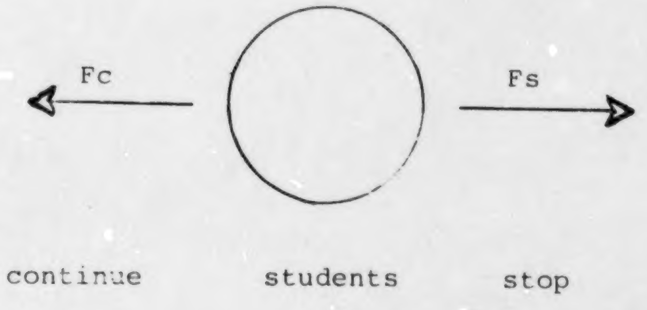
y = year = 12 months

Drop-out dynamics -- The number of participants in the tutorials are counted twice a week and the curve in Figure 4 contains an empirical 10% compensation for spontaneous absence (illness, dentist, etc.). It is interesting that the level at the end of the university year is close to the level of candidates. This indicates that the drop-out dynamics is not strongly connected to the formal examination at the end of the year, but to factors in the day-to-day life of the student, but which?

The exponential shape of the curve indicates a nature similar to the world of the atom. There are forces and spontaneous reactions to these forces. Figure 6 illustrates forces influencing the student to continue (Fc) or to stop (Fs).

Figure 6

Model for drop-out dynamics



Among the forces are self-evaluation of the day-to-day work at the university, spirit of "the corps of teachers", general prestige of the given education, economic conditions "here and now", labour market projections, alternative possibilities for education or employment and pressure from the family. One should be aware that such forces are additive, individual, and time dependent.

B – The Employment Development

For a long period in the 60s and early 70s we had a stable labour market for the candidates in the exact sciences dominated by the gymnasium and the institutions of higher education. But the picture changed in the middle of the 70s. Then we saw nontraditional jobs outside public research and/or education and we saw unemployment.

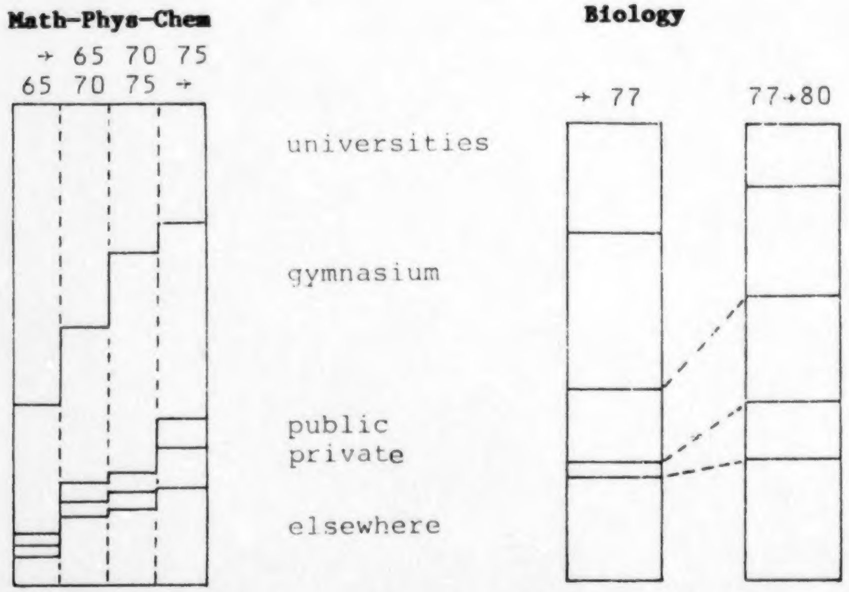
The official labour market statistics have a very limited value as bases for decision-making inside the university on educational matters. Disciplines with different labour market profiles are counted together, different institutions of higher education are aggregated, inclusive of foreign countries, etc. And the Ministry of Education and public opinion claims that the universities are the ones to blame if the labour market statistics show problems.

In order to produce a total picture of the labour market situation for the group of candidates from this specific faculty, the following was done. The candidates were listed, the jobs were classified and each member of the scientific staff was interviewed about the students (s)he had graduated by thesis. It turned out that all candidates within a few percentage points could be classified.

The picture for mathematics, physics, and chemistry and for biology is shown in Figure 7. The development is evident and confirms the general knowledge.

Figure 7

Employment development in Math-Phys-Chem and in Biology



The primary effect is the feedback into the scientific staff and the students; i.e., the group which is responsible for day-to-day decisions and work in a single department. Most do not have up-to-date knowledge and do not feel the responsibility and value of their own effort. This has been one of the factors influencing future education.

C - The Unemployment as Well-box

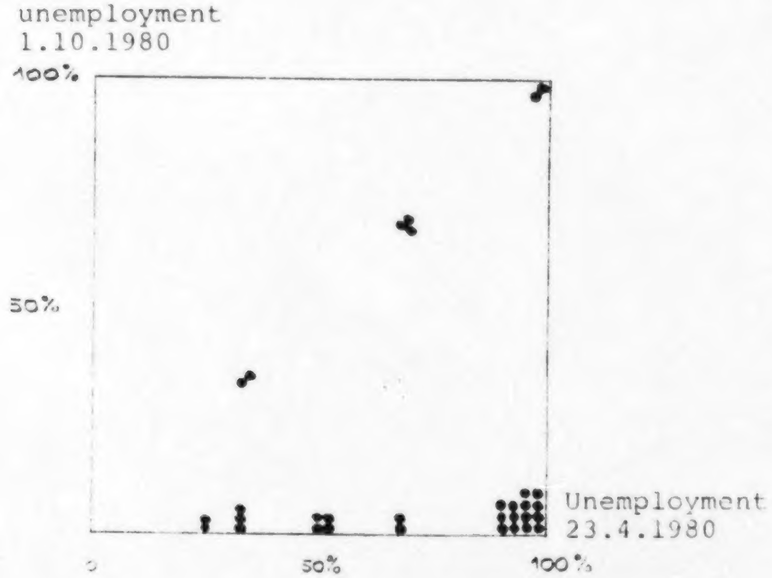
The situation for university-educated Danish biologists came under the focus of the Ministry of Education in 1980. On the basis of a high unemployment rate, it was decided to scale down the number of candidates. The number of new students was restricted and the finances were supposed to be cut down. The high rate was reported by the ordinary statistics of the labour market. This statistic is because of historical reasons not oriented towards the dynamics of the labour market; rather, it is concerned about totals.

It was observed that unemployment was stable. This implies that a number equivalent to the production each year was employed. This is after a relative expansion of 10%, the highest in the labour market.

To find the role of the group of unemployed, the tapes from "the Dole" were analyzed; in fact, the same tapes which are used for the ordinary statistics. The objective was to measure the turnover in that group. A low turnover indicates a severe problem, a high turnover indicates that the group is a component in the dynamics of an expanding labour market in the same way as the old fisherman's well-box. Figure 8 contains total or partly unemployed biologists from the University of Aarhus as of April 1980. It shows that 78% were employed six months later; if measured in full-time-equivalents this is 80%.

Figure 8

Biologists from University of Aarhus
Turnover in the group of unemployed



This information was one of the main factors in the decision to investigate the actual and future labour market for university-educated biologists. The investigation included biologists from the universities in Copenhagen and Aarhus. It was carried out by senior members of the scientific staff from both universities, who interviewed approximately 50 nontraditionally "employed biologist" and approximately 50 "employers" on location. They received assistants as compensation. All expenses were paid by the Ministry of Education.

One can see that knowledge of high value has been created inside the labour market and the university. This example of feedback will be effective in shaping the educational program, in the work of the individual teacher, and in the attitudes to the application of modern biology.

MANAGING FINANCIAL COMPRESSION: ONE UNIVERSITY'S EXPERIENCE

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Introduction

Retrenchment is one of the major contemporary challenges of modern university administration. Different universities have used different methods to deal with decline (see, for example, Mortimer and Tierney, 1979; Davis & Morgan, 1981; Mingle, 1981; Bélanger & Tremblay, 1982; Heydinger, 1982; Shattock, 1982; Dijkman & Savenije, 1983; and Simpson, 1983). However, as yet, comparative analysis of the costs and benefits of these different methods is limited. Much of the literature stems from single-case studies and armchair theorizing about the "best way" to retrench gracefully. This paper concerns a single-case study to be sure, but it is part of a larger project that compares different universities' attempts to deal with decline. Furthermore, by using multiple methodologies, it attempts to systematically document the various costs and benefits associated with the particular method of retrenchment. Another important aspect of this research is its contextualist perspective (Pettigrew, 1983). It seeks to locate the organization in its wider context; by linking *processes* (in this case the process of retrenchment) to the nature of the particular institution (*context*) and to the wider socioeconomic *environment*. It is only by understanding the interplay of these different levels of analysis that we can draw conclusions about *appropriate* rather than "best" ways to retrench: what is effective in one setting may be ineffective in another. Many studies of university decline have failed to incorporate the contextual and environmental influences that have to be accommodated by a particular organization. Finally, research on higher education has been criticized for being atheoretical (Chaffee, 1983). Such a situation is ironic given the accumulation of theoretical literature on decline. Although this is often related to settings other than higher education, the researcher has no excuse but to use existing theory and develop new ones.

The following, then, is a study of McGill University's response to budgetary constraints. Data were collected in a variety of ways: in-depth interviews of central administrators, deans, and a selection of department heads and professors; a questionnaire was distributed to all professorial staff; unobtrusive measures, including the analysis of available statistical data and documentation, were also used. It is important to note that this paper is a summary and many details have had to be omitted.

Cutbacks at McGill

The current problems are the result of long-term problems. The gradual decline of the seventies worsened in the 1980's. 1981 brought an announcement of further government budget cuts and a demand for a plan on how budgets would be balanced. For McGill to break even in 1982-83, 1983-84 and 1984-85, budget cuts of 11.3%, 5.9% and 5.9% would have been necessary although, as is explained below, McGill decided to spread the cuts more evenly. In total, between 1977-78 and 1984-85, the budget has been increased by 45%; however, the amount necessary to sustain the same level of activitiy and meet salary increases and non-salary inflation would have been 89%. The $44 million shortfall was met by reducing expenditure ($34.9 million), not paying salary increases ($7.1 million) and a $2.3 million deficit. Actual cuts, then, between 1977-78 and 1984-85 represented more than 30% of the 1977-78 budget. During this period student enrolment increased by around 20%. Further cuts of 1% are expected in both 1985-86 and 1986-87 (details from McGill Reporter, June 10, 1984).

McGill's Response

The Budget Task Force

One response McGill made to the need for cutbacks was the establishment of the Budget Task Force (BTF). In 1981 a report was written and presented to the Board later that year. This report clarifies the issues associated with the financial crisis and illustrates the thinking of the "university". It indicated the desire to use deficits to spread the impact of the cutbacks, resulting in cuts of 7.3%, 7.9% and 7.9% in 1982-83, 1983-84 and 1984-85 respectively.

Formula Funding

In terms of allocating the shrinking resources within the University, McGill has, for some time, relied on a combination of formula funding and a discretionary fund, whereby some resources can be reallocated between units. Despite the fact that formula-funding does allow some changes to be made in resource allocation, it is, essentially, much the same as accross-the-board cutbacks because choices, in the form of differential funding between low and high priority areas, are not made.

Opinions are mixed concerning the efficacy of formula-funding. On the one hand, such versions of across-the-board cuts are perceived as fair by members of the organization (Levine, 1979). However, as has been pointed out (Rubin, 1980), such perceptions of objectivity are illusory. Nevertheless, formula funding is perceived as a far more equitable basis on which to make cuts than, for example, selecting out units for closure or establishing low and high priority areas.

Despite the political expediency of this method of cutback, many writers have suggested it is ineffective (for example, Cameron, 1983; Zammuto, 1982). It squeezes good and bad departments alike and, in fact, inefficient departments that have built up a buffer of fat may be penalized less than efficient ones. Furthermore there remain questions regarding to what extent budget cuts can be sustained in this manner; eventually there comes a point where units can be squeezed no longer; eventually something has to be phased out. Many of the interviewees felt that that time was at hand, and that if they were to continue to be compressed at a general level, the quality of their programs would suffer.

Another problem concerns potential growth areas, which are not allowed to expand and, in fact, may be, relatively speaking, worse off as student numbers increase dramatically. The assumption is that the discretionary budget helps alleviate these problems; however, this is not universally accepted.

What else characterizes McGill's methods for retrenchment? A hiring freeze was imposed, but only for a short while in March 1981; a repetition seems unlikely.

Tenure

Tenure quotas are an equally contentious issue: although some central administrators are in favour of tenure quotas, others are completely opposed, saying it is detrimental to research, and attracting bright young people becomes difficult.

Attrition

Attrition has been used: between 1978-79 and 1982-83, 502 academic posts were vacated of which 308 were replaced, with 54 new positions being created. As a result the number of full-time academic staff decreased by 12% or 140 positions, worth $5.2 million. The reduction of part-time jobs saved $2 million and the removal of 300 non-academic jobs saved $5 million. The total saving, including benefits, was $13.9 million.

Early retirements are occurring: there have been about 15 special early severance retirements in the last four years, in which individual agreements have been negotiated. The university does not want to pressure people, especially with Bill 15. (A recent bill passed by the Quebec government restricting the right to retire employees solely on the grounds of age.) Nevertheless, a general scheme does exist, although many have argued it is not sufficiently attractive. The Budget Task Force recommended exploring this possibility in more detail. Meanwhile, post-retirement contracts continue: in 1983 there were five full-time and more than forty part-time post-65, salaried employees.

Sabbaticals

In 1981, an attempt was made to reduce the number of sabbaticals, to which there was a violent reaction by the academic staff. Central administrators feel that the system was abused and now the more frivolous applications have ceased.

Contract Renewal and Salary Policy

Another area that has borne the brunt of budget cutbacks has been the non-renewal of contracts. One thing has, however, at least reduced the need for not renewing contracts, and that is salary policy. McGill enjoys one advantage over the other universities in Montreal and that is, it is non-unionized. McGill was, as a result, able to curb salary increases to both academic and non-academic staff with the quiescence, if not always the approval, of the staff and faculty associations. It is important to note that McGill considers the difference between salaries at McGill and those of other universities in Quebec as money owing.

The university has relied extensively on this method of cutback. For example, the Budget Task Force went so far as to recommend that no further cash payments for salary increases should be made. There are mixed opinions regarding this, however.

The Outcome

McGill's approach to the cutbacks has been one of trying to reduce spending without dramatically disturbing morale, although it might be said the desire not to alienate the staff has, to date, taken precedence over the attempt to make differential cuts according to priorities. How successful has this strategy been and what have been the outcomes?

One result has been the near exhaustion of the unrestricted endowment: from $16 million in 1965 to $7 million in 1981, and to an anticipated

Table 1

Faculty Budgets as Percentage of Average of 76/77 and 77/78 Budgets (Constant Dollars)

	73/74	74/75	75/76	76/77	77/78	78/79	79/80	80/81	81/82	82/83	83/8
Agriculture	103.7	100.4	91.4	98.8	101.2	101.3	104.5	103.9	94.4	95.1	92
Arts	104.8	102.8	100.0	102.0	98.0	94.4	93.6	91.4	86.2	80.7	79
Dentistry	78.2	83.2	84.5	99.6	100.4	100.3	100.5	95.9	89.3	82.8	84
Education	94.3	96.9	91.5	97.3	102.7	95.5	91.5	85.7	80.0	75.1	72
Engineering(1)	100.5	98.9	97.5	99.5	100.5	99.3	98.8	97.5	93.9	90.1	89
Lib.Science	102.1	101.2	98.6	99.2	100.8	94.4	100.6	88.4	86.1	78.6	77
Soc.Wk	100.0	96.9	99.5	102.4	97.6	98.8	96.8	95.9	91.9	85.2	80
GradStudies(2)	94.4	93.7	95.8	98.7	101.3	99.6	102.[illegible]	101.8	95.5	88.6	88
Law	96.2	96.2	95.6	100.2	99.8	103.4	101.3	98.8	92.8	87.4	95
Management	58.1	79.7	94.3	97.5	102.5	100.7	105.7	105.0	101.2	98.2	97
Medicine	93.4	96.2	90.6	101.9	98.1	98.6	99.3	96.2	91.5	86.6	86
Nursing	87.6	87.0	93.5	94.7	105.3	106.7	103.5	77.1	67.1	61.8	57
Phys.&Occ.Th.	77.8	86.6	96.0	99.9	100.1	105.3	107.4	102.4	94.7	96.0	104
Medicine(total)	92.5	95.3	91.0	101.5	98.5	99.4	99.8	95.3	90.3	85.6	85
Music	83.5	89.6	91.1	94.5	105.5	103.5	105.5	103.9	102.3	94.4	94
Religious St.	87.0	86.1	94.1	97.8	102.2	101.3	98.0	94.7	88.6	81.2	79
Science(3)	107.3	106.1	102.7	102.1	97.9	93.6	91.7	88.7	83.6	78.5	76
TOTAL	97.0	98.2	95.8	100.3	99.7	97.0	97.4	97.0	88.8	84.1	83

Table 2

Numbers of Full Time Tenure Track Staff by Faculty

Agriculture	68	68	72	73	72	67	69
Science	227	221	221	224	219	205	198*
Engineering	112	117	114	118	115	109	110
Arts	233	208	209	209	212	203	192
Education	145	141	137	136	122	114	109
Law	24	25	26	26	26	25	28
Medicine	302	352	353	370	357	362	354
Dentistry	19	21	24	22	23	21	21
Music	38	39	38	36	37	38	36
Religious Studies	19	18	17	17	18	16	15
Management	40	48	50	52	50	47	43
Graduate Studies	28	29	30	26	25	28	33

*** Parasitology switched from Science to Graduate Studies and Research (5 people)**

Figures from University Planning Office, November 1983.

$1 million after the 1983-84 deficit is accounted for (details from McGill Reporter, June 10, 1984). Some might question the wisdom of using up capital but in the opinion of the administration the endowment was intended to help McGill survive period(s) of difficult times. Using the endowment avoided drastic actions which would have seriously demoralized faculty and staff.

How has morale been affected: in some faculties very little according to the deans. The questionnaire, however, revealed morale has been adversely affected by the cuts: more than three-quarters of respondents felt the affect had been somewhat or very negative.

Another potential problem brought on by decline is that of aging, particularly in faculties and departments that are "tenured in". The numbers of staff with tenure have increased: from 41% of all tenure-track staff in 1977 to 74% in 1983 (University Planning Office).

It is important to note how faculties have been affected differently. Worst hit in terms of budgets have been Education, Science and Arts, whose 1983-84 allocation was less than 80% of their budgets of the mid 1970s. Management and Law budgets, on the other hand were over 95% (see Table 1, figures from the University Planning Office). At the same time enrolment changes over the last ten years have differed between net decreases in Education and Science, to increases of more than 60% in Agriculture, Engineering and Management. Aging has also affected faculties differentially (see Table 2): with over 80% of faculty tenured in Education, Music, Science and Arts, less than 70% in Agriculture, Medicine, Dentistry, Graduate Studies and Management. Some faculties have been able to expand the size of their staff (as in Medicine, Management and Law), others have remained stable, a few have declined substantially (Education, Arts, and Science). The result of these factors is a dichotomy between those faculties that have had to absorb significant cuts, often with high tenure ratios, such as Education and Science, and those that have had to deal with the pressures of greater enrolment and decreased staff: student ratios, albeit with additional staff and relatively small cuts in funding. There are faculties, notably Arts, that have had to cope with all these pressures: significant cuts, high tenure ratios, increased enrolment, smaller numbers of staff, and declining staff:student ratios; while others, particularly those supported by research grants, remain relatively untouched by cutbacks.

The Reasons

This section examines some of the reasons that led to McGill's choice of strategy.

Unionization and Collegiality

One reason is the desire to avoid unionization, which might be provoked by disillusionment resulting from more selective cuts, phasing out of programs, breaking tenure, etc., which would, according to one central administrator, be "writing a ticket for unionization". Formula-funding also helps to maintain harmony among the deans; they are rarely in direct competition with each other.

Decentralization

Another reason for this approach is that McGill is a relatively decentralized university. The central administration as a group and particularly the two Vice Principals (Academic and Administration & Finance) do have power: power of veto; control over resources; power of expertise; charisma; moral persuasion, etc. Nevertheless, they see McGill as essentially a decentralized university, with considerable power resting with deans and department chairmen. This view is echoed throughout the university, and enhanced by the practice of giving faculties a one-line budget.

A decentralized process is far more amenable to formula-funding than it is to selective cuts; decentralization does not tend to produce hard decisions. As one dean put it: "You can't ask people to commit suicide". The problem is that making selective decisions in a collegial process is very difficult: collegiality tends to create self-protectionism and "decisional paraplegics" (Sibley, 1976), or alternatively, the result could be a political battlefield between different faculties and between the faculties and central administration. Consequently, formula funding becomes the easy way out.

Constraints and Facilitating Factors

Constraints

Any university faces constraints in making effective cutbacks: what restrictions does McGill face? One is that with the depletion of its unrestricted endowment a major source of slack for the system has disappeared. A second issue, discussed above, is the extent of decentralization. McGill professors are used to participating in decision-making: ignoring that could pose problems in the form of a political backlash, accommodating it takes time and tends to militate against the hard economic decisions that produce effective cost savings. Another general problem facing attempts to bolster morale and recruitment in a situation of retrenchment concerns the political situation of Quebec: language laws, high taxes and perceived instability have resulted in recruiting and turnover problems, particularly in some of the professional faculties such as management. Another constraint facing McGill, particularly if it has to address the closure of units or programs, concerns its commitment to the anglophone community of Quebec. This represents an additional criterion that has to be taken into account when making these already difficult decisions.

Finally, there are the general problems facing any university administration trying to make cutbacks, but which are particularly acute in decentralized institutions (see, for example, Hardy, Langley, Mintzberg & Rose, 1983; Hardy, 1984). These problems include the fuziness of the chain of command and the absence of clear-cut criteria for success.

Facilitating Factors: Planning

Planning is a double-edged sword in this respect: on the one hand planning systems have been developed; on the other hand they have run up against significant problems.

If cutbacks, or any form of resource allocation, are to be made on a selective basis, then it makes sense for these to conform to long-term objectives and established priorities. For this, some sort of planning system is required. Despite this earlier experience with both planning and deficits, the planning experience fell short of its potential. The problem is that effective planning requires the participation of the people affected, who are not always enthusiastic about the process.

Cyclical Review

There is an additional mechanism at McGill now: cyclical review. This was instituted to evaluate and review the quality of all the programs and units in the university. The review process is not publicly linked to the issue of cutbacks; instead it is stressed as a form of quality control and as a means to improve academic programs. Nevertheless, it is clear that inadequate quality may result in the phasing out of programs, while good reviews will help protect units.

There are a number of reasons why cyclical review could be a useful mechanism to effect cutbacks. Firstly, it is a systematic evaluation containing considerable information regarding the unit in question. A second reason is that cyclical review constitutes peer review, with external evaluators; something which lends credibility to the process. A further reason is that the review process itself may promote change by providing information and pointing out weaknesses. Its function as a catalyst could remove the necessity of central intervention. Finally, there is the fact that academics seem less antagonistic towards it than they do towards planning, although some maintain the workload is a problem.

Nevertheless, there are reasons why cyclical review will not act solely as a mechanism for cutbacks. It is designed as a continuous process that will evaluate quality and help identify priorities in the years to come, which means a review every five years. In fact, if cyclical review is to maintain its credibility, some units will have to be given additional resources. So although the planning and cyclical review systems may offer some help to administrators, they are unlikely to solve all their problems. (For examples of program review in Canadian universities see University of Calgary, 1980; Donald, 1982; Harris & Holdaway, 1983).

Access to Funds

Another source of flexibility for McGill is its balance sheet. Unrestricted endowment has proved crucial in allowing the balancing of budgets over time, although this is now almost exhausted. McGill, however, also has real-estate which it has sold in recent years to acquire cash.

Of particular importance has been McGill's success in the raising of research grants and capital campaigns. The success of the latter has been largely attributed to the current Principal. There have been four development campaigns since the Second World War raising $52 million. The current one, announced in September 1983, is by far the most ambitious: to raise more than $61 million. This money will be used to fund priorities established by a committee that received "wish lists" from each faculty. McGill has also been able to increase its research funding. Research funding has increased continuously (in constant dollars) since 1980-81 by nearly 60% (McGill Reporter, June 20, 1984).

Collegiality

There are a number of other factors that might be considered as providing flexibility and facilitating McGill's response to the cutbacks. One of these is the sense of institutional loyalty, which manifests itself by the non-unionization mentioned earlier.

Another source of flexibility may be the collegiality that is considered to exist among the deans. It is important to remember, however, that although these factors help McGill make cutbacks, they also restrict freedom of choice. Such an environment has to be protected and nurtured. This rules out certain actions, or at least makes them difficult: selective cuts will threaten collegiality and loyalty; excessive pay restraint may endanger cooperation. As the context influences the process, so does the process change the context.

A final facilitating factor seems to be the support that central administrators have from the unviersity community.

Conclusions

The Process

What conclusions can be drawn from the McGill case-study? At the theoretical level it is clear a number of different factors influence the phenomenon of retrenchment; that different universities face different influences. McGill's problems regarding the source of its budgetary pressures are much the same as other universities in Quebec: reduced government funding. However, in other respects, McGill's situation may be different. It has access to sources of flexibility that other universities may not: a non-unionized staff; (previously) unrestricted endowments and other sources of cash; an ability to attract considerable sums of money through capital campaigns and through external research funding. On the other hand, McGill must face complicating factors in the form of the decentralized nature of the university and its commitments to the anglophone population of Montreal. If we are to understand the process of retrenchment in McGill, and make recommendations, it is important to take into account both the wider environment and the characteristics of the organization. Administrators should not be looking at the "best" way to retrench, but the most appropriate.

It has been suggested that different causes of decline may necessitate different responses (Levine, 1979). If this is the case, it must be noted that the predominant cause of decline in Quebec schools, and in Canada generally, is budgetary. This contrasts with American universities which have faced declining enrolments for a number of years (see, for example, Cheit, 1973), as well as fiscal pressures. Another significant difference between the two countries is that the U.S. schools often have more flexibility. Managing budget cuts with increasing enrolments without the foreseeable option of terminating tenured staff or increasing fees is a difficult proposition. It is important to recognize that the lessons supposedly provided by American studies need to be carefully weighed by administrators to see if they are applicable to the Canadian context.

Another factor to be taken into consideration is the particular institution: McGill is a reasonably large, decentralized, anglophone research institution in a francophone province. It, as a result, may have to manage cutbacks quite differently than other Canadian universities. Furthermore, each university has its own agenda or philosophy regarding the factors it considers important in managing cutbacks. McGill has responded to its situation by trying to temper its efforts for a balanced budget to protect morale and commitment. To some extent, McGill had to adopt this route in deference to the nature of the university; in other ways McGill has been able to make that choice because of its flexibility. McGill is, in essence, trying to combine both a political and economic approach to its problems (see Hardy, 1984).

A Political-Economy

A totally economic approach would result in centrally-imposed, differential cuts being made according to clearly established priorities -- that would be the most cost-effective method of retrenching. But universities have other needs: the accommodation of an entire university community, possibly only with political and social skills. In effect, the aim is to accommodate the participative nature of the university, bringing it to bear on the problem of retrenchment, without incurring a political battlefield. The result is not always, economically speaking, the best, but it allows the university network to continue in something like a collegial relationship.

The recognition of both political and economic factors is a useful way to analyze retrenchment, by drawing on the concept of a political-economy (Warmsley & Zald, 1973). Fiscal pressures may be forcing economic considerations more to the fore, but universities have long been considered to have political elements (Baldridge, 1971; Hardy et al., 1983). Furthermore, decline itself tends to exacerbate political activity as resources shrink (Bardach, 1976; Hardy, 1982, forthcoming). Any administrator that takes a purely economic approach to university cutbacks would be risking a political backlash, as well as endangering the viability of an institution in which expertise and knowledge rests in the lower levels of the hierarchy (see Mintzberg, 1979; Hardy et al., 1983). Administrators need to deal with both economics and politics; reconciling planning and participation (Hardy, 1984). The challenge is how to bring the system of decentralized decision-making to bear on the problems of cutbacks, enabling administrators to avoid political conflict, keep academic judgements at the level of the most qualified professors, *and* produce effective cutbacks which reward and promote quality.

Externally a political-economy framework is also required. The focus of this paper has been on McGill's internal strategies designed to retrench smoothly but, as Levine has pointed out:

> Strategies for dealing with decline will be a mixed bag of tactics intended either to *resist* or to *smooth* decline. The logic here is that no organization accedes to cuts with enthusiasm and will try to find a way to resist cuts.
> (Levine, 1978, p. 319-20.)

Strategies to resist cuts are directed externally and if successful, either reduce (or remove) the need for cuts, or provide additional flexibility to make them less of a crisis and provide administrators with more room to maneuvre. These actions are both economic in nature, for example raising funds as in McGill's capital campaign, and political, for example, attempts through political bodies to legitimize universities and their need for funding (Das, 1980; Cameron, 1982; Jick and Murray, 1982). The political dimension of externally-oriented actions is particularly important in times of economic scarcity (Bower & Doz, 1979; Child, 1979; MacMillan, 1979). There is, however, sometimes a dilemma between political and economic responses: political resistance may necessitate refusing to take action which may exacerbate the economic nature of the problem by, for example, increasing deficits. Conversely, deferring to economics by making quick and effective cutbacks can weaken any political stand that tries to argue the cuts are damaging. One final point to note is that the political/economic mix in the response of the organization will have to conform to the political/economic nature of the problem (see Levine, 1979). In other words a political response (e.g. lobbying) to an economic problem (e.g. significant enrolment decline) will be as ineffective as an economic response (finding new students) will be to a political problem (reduction in government grants). This, once again, emphasizes the importance of finding an appropriate way of managing cutbacks.

McGill's Success

Finally, there is the question of how well McGill has managed its cutbacks. On the negative side, questionnaire respondents were highly critical of their ability to influence faculty and university budgets (more than half rated it as poor or very poor). Moreover, more than three-quarters of respondents felt that individual and departmental morale had been very or

Table 3

Attitudes of Professorial Staff: Responses to Questionnaire

Please evaluate the following aspects of the university by circling the number beside each question which most closely expresses your feelings.

1 - Very poor
2 - Poor
3 - Average
4 - Good
5 - Very good
No - No opinion or question doesn't apply

	Percentage Responding					
	Poor			Good		
	1	2	3	4	5	No
Your present annual salary	5	31	28	26	10	0
Extent of faculty participation in the determination of academic policies and procedures	6	16	30	34	11	3
Your general confidence in the leadership of your faculty	7	15	20	39	18	1
Your general confidence in the leadership of the university	5	18	25	40	11	1
The value of the University Senate as an avenue for faculty influence	12	21	31	11	4	21

Table 4

How fairly do you think the budget cuts have been made within your:

	Department %	Faculty %	University %
Very fairly	30	13	6
Somewhat fairly	51	51	41
Not very fairly	9	18	25
Not fairly at all	7	8	15
No opinion	3	10	13
	100	100	100

somewhat negatively affected by the cuts. One third also felt their salaries were poor or very poor. However, generally speaking, the university was perceived to be dealing with the cuts as best they could. Only 21% felt faculty leadership was poor or very poor; 22% felt the same about university leadership (see Table 3). Commitments were rated high to their university (75%), faculty (78%), their department (88%) and their job (97%). People did not blame central administration to any great extent for the cutbacks - only 10%, compared with 85% who attributed the responsibility to the government and the economy. The cutbacks were not pushing individuals to join either faculty unions or associations: less than 1% said they were very likely to join such an organization in the near future. While individual professors perceived themselves as having little input into cutback decisions (7% as compared with 36% for central administration, 29% for deans and 27% for department heads), only 7% felt cuts at the departmental level had been unfair, 8% at the faculty level, 15% at the university level (see Table 4). Furthermore, only 3% felt friction had increased a great deal because of the cuts; collegiality and autonomy had also emerged relatively unscathed.

McGill has, perhaps, made two errors that have left staff unimpressed. One is the request, as part of the capital campaign, for funds from employees, a somewhat insensitive move in the eyes of many people, in the light of the salary increases they have foregone. The second is also related to salary policy: an arrangement was made in lieu of a pay rise in 1983-84 for employees to be able to join the Faculty Club at a reduced, and heavily subsidized, rate of $12.00 per annum; many would have preferred to decide how to spend their money for themselves.

In terms of whether McGill has suffered by avoiding selective cuts, it is dificult to say. Initially the cuts do not appear to have caused too many problems although the critical point may not have been reached in many faculties. Resources have been reallocated via the discretionary budget by between one and two percent per year, which seems in line with many other universities (see Zammuto, 1984). The crunch will certainly come, however, if funding difficulties continue, or if projected enrolment decreases manifest themselves: the problem of retrenchment may not be over.

NOTE

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THE NATURAL HISTORY OF A REORGANIZATION PROJECT

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Reorganization as a Social Process

Generally, the necessity of reorganization of universities in The Netherlands is justified by authorities by citing a loss of quality and efficiency in the 1970s, although of course cuts in national budgets are the prime mover. The relationship between cutbacks and quality is, however, very vague and based more on rationalizations than on solid analyses: let us not forget that presumed lack of quality provides only the legitimation because there would have been cutbacks even if high quality of research had been demonstrated beyond any doubt.

We can see, however, that in most subfaculties there is no objection to the connection between reorganization on the grounds of quality and efficiency and cutbacks. There are two problems with such a reorganization:

(1) the lack of consensus on quality -- even among planners there is only agreement about some indicators, and

(2) the expressed opinion that lack of quality only exists in other departments.

This was also the situation in the subfaculty of the social-cultural sciences in the University of Utrecht. People agreed on the idea of reorganization, meaning in their eyes resignments in other departments. And most of them expressed the opinion that quality must be the keystone. But the question was how? The conditions raised by national and local planners were mostly seen in the subfaculty as rationalizations of the financial position of the government, with no eye to the needs and processes of education and research. These planners were seen as bureaucrats who didn't have enough quality to start or maintain a research career. Even staff members with planning aspirations were seen as members of this caste. But most members of the subfaculty were at the same time afraid that the arrogant and powerful planners would be invited back when the reorganization didn't succeed. There was a feeling that it was "better to do it ourselves" because on a higher level there are only rough methods to work with.

I will outline the subfaculty's situation, the transformational strategy, and the consequences of reorganization in Utrecht. The central issues are the following:

(1) the question of whether the preconditions were suitable for a reorganization on the grounds of quality; and

(2) the question of which strategies are needed to make abstract models workable.

An Outline of the Subfaculty's Initial Situation

The Need for Reorganization during Autumn 1981

It became clear for the first time that the subfaculty of social-cultural sciences (containing the department of cultural anthropology, 'town and country planning', and sociology) was confronted with a structural deficit.

This deficit was caused by a decrease of the total numbers of students -- 1,000 in January 1980; 800 in January 1982 -- and an even larger decrease was caused by the introduction of a new defrayment system which cut the input of teaching staff back nearly 40%. This new model was introduced by national planning circuits to cut down educational spending. Only an excessive degree of efficiency and a shift from teaching-capacity to research potential could save some of the inevitable loss of quality in teaching programs as well as manpower. It was obvious that one could not hope for a natural reduction in view of age-composition and the pursued policy of permanent appointments. From sheer necessity, a request for reorganization was proposed to the Board of Administrators.

Preconditions

The Board of Administrators stated the preconditions in April 1982. A 10% decrease of teaching and research staff had to take place simultaneously with the appointment of approximately 20% more temporary staff (junior researchers). Approximately 80 staff members were affected. In plain numbers this meant the potential resignation of approximately 25 staff- members, but also the appointment of approximately 20 junior researchers. The figures pointed out that one in five staff-members was involved. That means there was of course a situation in which people tried to arrange strong and weak positions before the process started as well as during the process.

The total loss of positions was, however, rather limited if the subfaculty could find a way to shift teaching capacity to research potential. This task was rather difficult, keeping in mind the different contractual basis and assignments of permanent and temporary staff.

'Learning by Doing'

The reorganization of the subfaculty was one of the first at the University in Utrecht and in Holland. As there was no expertise, it was a process of 'learning by doing', both for the subfaculty and the local central organization of the university. On the one hand, the relationship between the subfaculty and the central organization was one of negotiations about the input and output figures, and on the other hand it was a partnership or even prisoner's dilemma partnership: the Board of Administration needed a good example of a reorganization process and the subfaculty was trying to realize their policy of "taking the benefit of being the first".

The problem for the subfaculty in this relationship was that it could not be sure of its juridical solutions -- because the central organization was unsure on this matter -- and it was not clear which employees of the central organization would be the key persons in judging the reorganization concept. But on the other hand, this situation gave the subfaculty the opportunity to search for solutions which were not limited by too narrow preconditions.

Complicated Structure

Besides the preconditions in the sphere of resources, conditions were made with respect to procedures. The administrative structure of Dutch universities is complicated with a system of committees deciding on educational and research policies, a Board of Administrators determining the input of volume and kind of expedients, a departmental level performing education and research, and detailed procedural guidelines, mainly because of the presence of civil servants' trade unions and the so-called ARAR, the Civil Servants' Rules for legal status.

Breaking Through an Old Adequate Policy

The explosive growth of the subfaculty in the years 1965 to 1975, a result of the increase in students, had -- although there was some planning -- in the end led to a situation of a myriad of unconnected specialities in education and research. The growing budget was used not only to finance this differentiation/heterogenisation in reseach and teaching, but also to avoid clashes between adherents of different theoretical and methodological schools as well as to promote competition between departments. Although this policy led to a workable situation, the cutbacks imposed in the period immediately preceding the reorganization brought this policy to an end. The new conditions required a new policy. It was the task of a special committee -- set-up for this situation -- to use this consensus to create a plan that combined two elements:

(1) workable conditions -- for the internal arena, and

(2) promotion of quality and efficiency -- for the external judges.

Notably, the social and juridical conditions are problematical if reorganization based on quality has to take place. Deviation of resignational sequence -- according to ARAR -- means either termination of the position (requiring substantial argumentation) or evidence of service-interest. This also is very difficult. Adding these elements to the distinctive advisory and decision circuits and organs, it will be obvius to everyone that reorganization of Dutch universities is anything but a simple job. In short, it means tension between social policy and quality increment on the one hand and efficiency and viability increase on the other hand.

An Enunciation of Transformational Strategy

To steer the reorganizational process into good channels, the subfaculty board initiated a reorganization committee. It consisted of one staff member, one technical administrative member (also secretary of the subfaculty), and one student member. A small committee was preferred because of the desire for swift action.

One of the most important points was the selection of the members. All members selected were a priori in an unproblematic position in terms of resignment. Another selection point was the amount of acceptance of the members for confidential discussions of alternatives. And a last selection point was the large network of the members. Each member of the committee had during the process some 'backstage' groups with which to check ideas informally. In terms of the possible coalitions, the members of the committee could be seen as representatives of various groups.

Another important point was that all members knew the local and national highlights about planning and reorganization, and although they did not like much of the -- also in their minds -- rationalizations of the cutbacks, they accepted the political power relations within the limits of the preconditions after a period of negotiation.

The thinking in the committee was pragmatical. The committee wanted:

(a) to be the first,

(b) to try to interrelate the subfaculty's interests and the interests of the Board of Administrators, and

(c) to get the best conditions for a process that was inevitable.

The committee's tasks were:

A. A reconsideration of objectives and starting points for education and research and its organization, all within the framework of advancement of flexibility, quality, and efficiency.

B. The computation of possible consequences of certain choices.

C. A concrete proposal for reorganization.

As far as 'A' was concerned the following objectives were selected:

1. continuation of existing pluralism in scientific conceptions, applications, and disciplines;

2. tuning of educational facilities to research specializations, in view of the resources-mode of allocation;

3. selection of specific 'Utrecht' main points to profile within the framework of national distribution of tasks and cooperation between universities.

4. In practice this led to a selection of fields and research-teams considered viable for inclusion in the so-called 'voorwaardelijke financiering', a mode of research-financing of which pecuniary input depends upon positive judgements of external expertise (both program -- in terms of coherence and range, and individual researchers in terms of 'creditworthiness' -- are subject to judgement).

This point provided the opportunity to bring the element of quality into the process.

Of course there was a lot of opposition from nearly every group in the subfaculty because, after all, there was pain to divide. And there were a number of other conceivable ways to deal with the situation. Of course there were people who wanted to use the reorganization to solve their quarrels and conflicts with others. Black sheeps were cheap at the market at that time. And also there was the possibility to establish or re-establish status in new pecking orders. This is an important issue because there is also a life after the reorganization ... for those who stay.

To overcome all these points it was necessary for the committee not only to keep the support of their own groups, but also to get the support of other groups.

Various strategies were needed:

(1) Social strategy

- Quick kill

  Quick kill implied a detailed elaboration of the plan during the summer holidays -- after an initial rough instigation -- so that upon returning from holidays everything was ready, no time being available for the planning of all kinds of counter-productive alliances and coalitions (at least in the committee's conception). Besides there was an unexpected effect: good press for "those people who gave up their holidays".

- Separated audiences

  The committee members were in contact with small backstage groups. Small parts of the plan were discussed in different groups. This gave the opportunity to get indications of the degree of commitment and at the same time staff members got used to ideas while only the committee knew the whole plan.

- Key persons

  In the relationship with the central organization of the university the committee tried to find some key persons who wanted to commit themselves to the plans. There were key persons needed from the organization-section, the ARAR-section, and the financial-section. Two members of the committee visited (one weekly) the central organization to check some ideas and to get commitment to the options.

(2) Ideological strategy

The committee built a new conception for the faculty based upon old pieces with a touch of a new spirit. This conception was concentrated in the slogan "society oriented education and quality in research". Nobody could deny the relevance of these items and once adopted nobody could deny that the reorganization was a step forward (not always a good thing when you are in front of danger). But there grew a consensus that, overlooking the arena, the plan was not bad in hard times.

(3) Political financial strategy

The committee used an overkill strategy, meaning an overdose of discontinuancies and, implicitly, more resignation potential than strictly required. This was considered necessary, given the chance that certain parts of the plan would be unfeasible during the formal procedural settlement in the distinct circuits.

Only the overkill method guaranteed the nondiscussion of most qualified fields and research teams. This also led to the expectation that the subfaculty's official decision-makers would get a feeling of success ('We saved some things after all').

Although the committee could work with a small majority from the start, based upon their relations, they succeeded in getting the largest possible majority by the way they used all the strategies mentioned. After the final decision, the joke of the committee was that only totalitarian systems could copy such a score. Maybe this was the grounds on which an important national weekly called one member of the committee Professor Asser (the Jewish chairman of the Jewish committee during the Second World War in The Netherlands), and another Stalin; classifications that do not need further comment, I think.

A Survey of Reorganizational Consequences

In terms of efficiency, the reorganization was a success. Organization-wise a simplification has occurred: nine departments have been reduced to six; the time necessary for running the subfaculty has been reduced by nearly 50%; and after all that the subfaculty carries out more education and research tasks with a decrease in costs of 10%.

The reorganization was also a good investment for an outline of the subfaculty that was later necessary in the overall national reorganization operation, in the reorganization of the socal sciences in Utrecht, and in the selection of concentration fields in sociology and anthropology. The subfaculty had formed an answer to all these challenges even before the issues were really raised. The reorganization resulted in the concentration on six major files while a large number of minor fields have been abolished. All these new fields got the opportunity to develop a united research program, extensive and outstanding enough to participate in the 'voorwaardelijke financiering'. All these fields were specialist teaching fields as well.

In terms of social relations, we could say that the personal relations are at least as workable as before in the whole organization, and in new-formed teams there is enthusiasm to create new research-lines.

The commitment of the central organization to the concept of reorganization is nearly complete. Only the ARAR-section does not agree with the resignation of two part-timers.

The process of 'learning by doing', in which a limited degree of freedom is given to the subfaculty itself, has given a lot of information to the central organization. In subsequent reorganizations the central university authorities have formed a small team that knew enough to advise reorganization committees on all issues. As a result you can see now that reorganization plans are more detailed than in the case of the social-cultural sciences. This means that the central authorities know better what is really done while at the same time the subfaculty is in a better position to make the concept come true because when the aims are not detailed enough old conflicts get the chance to make a comeback. After all, you must not forget that the preconditions of ARAR for reorganization at Dutch universities always include the problem that you have to fulfill new aims with most of the same old key persons.

In terms of quality, there are two sides of the coin. The financial base (PGM) always implies a loss of quality in the education section. The only thing that could be done was to make this loss as small as possible. In trying to achieve this, the committee chose several ways:

(1) combining sociology and anthropology in the first year of study;

(2) combining small teaching fields;

(3) introducing an internal financing system;

(4) trying to develop more cross-overs for students in the subfaculty;

(5) finding new tasks.

The shift from education capacity to research potential was conditioned by the university as only junior researchers could be brought in. This resulted in the following process:

(1) Older experienced permanent staff members, mainly active in education, retired; most of them because of the social pressure to resign and to give young people a chance, and no doubt because of the excellent unemployment benefits for civil servants which was unquestioned at that time.

(2) Experienced permanent staff members had to take over most of the activities of the departing people which meant a loss of their research time.

(3) Several junior assistants have been appointed for a period of four years. They need the attention of experienced staff members. This means a second loss of the research time of this experienced staff.

This whole process means that there is an investment from experienced staff members in temporarily employed young researchers, an investment in an uncertain future with limited opportunities to promote the expertise of the permanent staff. Perhaps it would have been better to reserve some money to hire more experienced staff. This is one side of the coin. On the other side we see that there is quality enough compared to national standards because all locally selected research programs were accepted for 'voorwaaradelijke financiering'. The implicit quality strategy has worked out.

It is too early for a more definitive answer. The new concepts in education and research work, although there are some tendencies of restoration (thermidor) because new compromises have to be made after the 'revolution'.

Overall we could say that the proposition of, for example J. de Smit, that the university is not able to change itself is at least not completely true. After all of the disappointment with financial and education/research planning in the university with topdown models, this reorganization pointed out that it is possible -- even with different opinions -- to plan changes in costs and aims in an interrelated process between top and bottom under unfavourable conditions. All of the people involved in this case succeeded in fulfilling the same tasks again in the reorganization of the social sciences in Utrecht a year later, under even worse conditions which included a 20% decrease in costs and in a more conflicting situation between students, departments and subfaculties.

COLLEGE AND UNIVERSITY RETRENCHMENT: ITS IMPACT ON NON-ACADEMIC REVENUE SOURCES

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The fact that universities world-wide have found their traditional sources of funding eroded in recent years is well-known. Administrators and governing boards have been hard-pressed to identify additional sources of revenue to offset the lack of tax supported resources (see Keller, 1983).

In keeping with the theme of the Conference, Beyond Retrenchment: Planning for Quality and Efficiency, this paper responds to one theme question, "Are we willing to develop and use techniques and characteristics of profit-making organizations?"

One area under the control of the universities which has been summoned to maximize income is the Auxiliary Services (Clark, 1984). Auxiliary services or enterprises are defined as those entities which exist to furnish goods or services to students, faculty, or staff and which charge a fee that is directly related to, although not necessarily equal to, the cost of the service. The general public may be deliberately or incidentally served by these auxiliary enterprises. At most colleges and universities in the United States, these auxiliary services include, but are not limited to, bookstores, student housing, student unions, intercollegiate athletics, printing and publications, and parking.

Over the past few years, administrators at West Virginia University have conducted a study of the methodology of past allocation of resources within the University. The major goal of this study was to determine whether or not WVU could continue to justify its level of resource allocations to various academic and non-academic units (West Virginia University, 1984). In part, the study was a test of a policy which had been in effect for many years regarding auxiliary enterprises. This policy stated that all auxiliary units of the University must generate sufficient income from their resources to pay all unit operating expenses, and would receive no state-appropriated funds.

This paper reports on two phases of this study. First, the concept of cost accounting is discussed in terms of its application to auxiliary enterprises and second, some consequences -- both expected and unexpected -- of West Virginia University's full-costing management style vis-à-vis the administration of Auxiliary Service Units are presented. The auxiliary units studied included the University Bookstore, University Housing, the Department of Athletics, Parking and Transportation, and Printing and Publications. Results of the study of this policy as applied to these units indicate that:

1. Application of cost accounting procedures -- full-costing of auxiliary enterprises for the purpose of recovering central costs incurred on their behalf -- is a new and powerful concept in higher education and,

2. New policies must be developed to oversee the self-funding of auxiliary service units as part of the University.

These results were anticipated and are discussed in the first section of this paper. However, other consequences, both anticipated and unanticipated, which have significant policy implications relative to the operation of these auxiliaries were also discovered. A discussion of these consequences constitutes the second part of this paper.

I - Cost Accounting and Auxiliary Enterprises

Cost accounting procedures -- full-costing of auxiliary enterprises for the purpose of recovering central costs incurred on their behalf -- can be particularly useful in the auxiliary enterprises area in part because of the similarity between the auxiliaries and service operations in private industry. Some auxiliaries (food service and housing, for example) provide services during specific time intervals, others, such as bookstores, provide consumer goods and services. Auxiliaries, however, do differ from service industries in that they are an integral part of student services.

At West Virginia University, auxiliaries are managed basically as self-supporting activities, although sometimes a portion of student fees or other support is allocated to assist these activities. In order to be fully self-supporting, an auxiliary enterprise must generate sufficient revenue to cover both direct and indirect costs. Indirect costs can include a share of central administrative expenses, debt service, and provisions for renewal and replacement of facilities and equipment.

Cost data enable managers to make informed decisions concerning the prices or fees to be charged for auxiliary services and to identify high-cost areas and evaluate the cost of providing alternative levels of service. Cost data are also useful in comparing the costs of in-house services with the cost of contracting with external vendors.

In auxiliary enterprise, pricing and subsidization decisions present the most important opportunity to use cost data. Such decisions are necessary in every area where fees or prices are charged. Cost analysis however, becomes more complex at lower levels of disaggregation. In setting prices in the bookstore, for example, the analysis must consider costs of specific product lines. Cost accounting procedures may also help in the examination of historical trends and projection of future costs.

In summary, there are three advantages of collecting cost data on auxiliary enterprises:

1. Control - In controlling current operations, cost information is a valuable indicator for identifying areas in which current budgeting adjustments may be required or corrective actions needed. The control process involves the comparison of incurred cost to budgeted cost, and any variances are examined to determine appropriate action.

2. Evaluation - Cost information is important in the evaluation of performance. Evaluation involves an after-the-fact exam-

ination of results and assists in determining whether the activities conducted were as effective as anticipated. Evaluation also involves an analysis of revenue to determine whether the activities should be reduced or eliminated.

3. Pricing - Cost information is important in evaluating and setting prices for goods and services.

The inclusion of these principles in university management will be productive when attempting to maximize the financial return from auxiliary services.

II - Consequences of Full-Costing of Auxiliary Services

Historically, the auxiliary service units have maintained that their emphasis has been on "service" and not "profit". However, as the universities' search for income sufficient not only to maintain themselves, but also for additional funds to be applied to general university expenses, auxiliaries find that their goal of service is being distorted towards a profit-making enterprise. This goal distortion manifests itself in a number of ways, not all of which are desirable. Some specific examples of these consequences of full-costing of auxiliary enterprises and implications for University Administration are as follows:

1. A profit orientation rather than a service orientation.

   Hopefully this change in orientation can occur without compromising the University-nature of the institution. This is an important consideration and by its very nature the evaluation is subjective. Some opponents of this shift have suggested that the actions taken by the West Virginia University administration reinforce a profit-making attitude at the expense of the service orientation. Since a university service environment is held to be desirable, care must be taken to ensure that employees continue to believe they are full members of the academic community and not independent contract employees.

2. Staffing attitudes oriented to "collecting money" rather than providing a service.

   There have been documented instances of an attitude of "I am now earning my own salary, therefore, I should have complete freedom in the operation of the auxiliary enterprise." This attitude needs to be closely monitored as it reflects on the fundamental purpose of the service commitment within the University. These units remain part of the University community and therefore must be subject to the same rules of conduct as are units that are supported by State appropriations. This can be an especially significant problem in units that have large cash flow situations or who are subject to sudden and unanticipated increases in receipts. The best example of this is in the Athletics Department. Intercollegiate athletics in the United States enjoy great popularity and wide support among alumni and friends of the University, especially legislators. Winning teams are seen by huge crowds which generate many dollars. Last year at one West Virginia University football game the combined revenue from gate receipts and television amounted to more than $1 million. This is by no means unique. A number of institutions routinely receive more than $1 million for one game. With these amounts of dollars at stake, it is quite easy for the athlelic department administrators and staff members to believe that since they have generated this money they should have complete independence from the University in deciding how it shall be spent. Therefore, it is important that specific policies be developed to address the areas of financial responsibility vis-à-vis the auxiliary enterprise and the University at large.

3. A sharp decline in inventory of "non-profit" items in the University Bookstore in favor of "drugstore" items of high profitability.

   Some universities have adopted the philosophy that "bookstores" be permitted to sell virtually anything. These stores quickly become similar to a general department store rather than a traditional bookstore. Presently, West Virginia University has not permitted the bookstore to merchandise in this manner. There is pressure from West Virginia University's Bookstore management to include the variety and the type of items which are typically sold in bookstores in universities in the United States. Many of them routinely sell, in addition to books, sportswear, glassware, souvenirs of various kinds, greeting cards, and general office supplies. If department store type of sales are permitted, the University administration must be prepared to deal with complaints from merchants throughout the community. Such rivalry can result in serious conflict between the institution and the local business community and can, at least indirectly, affect the institution's financial support base.

4. A sharp decline in the overall inventory of the Bookstore and a greatly reduced inventory of "great works" and an increase in popular soft-cover novels.

   This is certainly to be expected and may not necessarily be negative. The United States still professes to be a capitalistic country, and we are simply giving the consumer what they want.

5. Elimination of discounts on purchases.

   The West Virginia University Bookstore has eliminated one discount and is considering the elimination of a second. The discount that has been eliminated was a general 5% discount of all text books purchased by students and staff. The discount which is being considered for elimination is a 15% discount on institutional sales; that is, sales made to departments within the University, usually in the form of office supplies. It is argued that such intra-university sales constitute the transfer of money from one pocket to another, thus, making the elimination of the discount pointless. However, the counterargument is that the elimination of the discount will cause the departments to apply more discipline and be more selective in their purchases from the Bookstore. Again, administration needs to monitor these kind of activities carefully so that they meet a test of both prudence and reasonableness.

6. Intercollegiate athletics becoming entertainment with a "win-above-all-else" philosophy.

   This is a severe problem throughout the United States and one which many hours have been spent by educators in attempting to solve. The problem is not limited to athletics being just financially self-sufficient at West Virginia University or at any other large institution. Athletics are very popular at large institutions and indeed, are very important to the institutions for maintaining political, financial, and popular support for the institutions. This may be a sad commentary on U.S. higher education but nevertheless, it is true. Unfortunately, universities in the United States have taken on the burden of providing entertainment as well as education to our constituents. Having accepted this entertainment function, the universities continually find themselves torn between the education mission of the institution, which is always considered as the prime mission of the institution, and at the same time providing sufficient resources to ensure that the young men and women participating in the athletic programs are provided the counseling they need in order for them to complete their education and receive their degrees. Much publicity and attention has been given to the argument of whether athletes are being treated fairly. The role of intercollegiate athletics within the University, therefore, must be defined by the administration in order to direct and maintain proper perspectives.

7. The elimination of some non-revenue sports simply because they are non-revenue producing.

   This is self-explanatory and instead of considering the value of athletics for the sake of participation, they are lately being judged on whether or not they can be self-supporting.

8. The desire of the student union director to levy a fee for the use of meeting rooms in the building.

   Previously, this has been a free service. The student union of West Virginia University over the past several years has been required to absorb charges totalling $265,000 for overhead and utility costs. This is a considerable amount of money, both in isolation and as a percent of their overall budget. As a result, the director has requested that he be permitted to charge for space that is used by the University for general purposes within the student union building. As of this date, space charges have not been permitted at West Virginia University. There needs, of course, to be a test of reasonableness in both the assessing of fees against the student union as well as the taking of potential marketable space for other University activities. Rules must be realistic and cannot direct that the student union cannot generate sufficient funds to support itself as well make a contribution to the general University, and reciprocally, be deprived of prime market and retail space which they need in order to earn this money.

Summary

The administration at West Virginia University, being fully aware of the consequences, has required all auxiliary services to be fully self-financed. The implementation of this decision has not been easy nor without controversy. Philosophical questions concerning the purposes of universities and their proper activities continue to be debated. Because of their nature, these arguments will continue and it is unlikely they will ever be resolved. However, despite these arguments, West Virginia University has made the decision that auxiliaries should not only be self-supporting, but should contribute to the general expense of the University. Nothing that has transpired to date would indicate that this decision should be changed.

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TECHNOLOGY TRANSFER FROM UNIVERSITIES INTO INDUSTRY

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There is a wide variety of technology available from universities, each requiring its own mechanisms for successful transfer to industry. In the first instance let us consider a resarch team built up over ten to twenty years. As a result of successive funding and research a corpus of expertise will have been accumulated. Allied to that there is usually a continuing dependence upon the institution for building services, equipment, staff and essentially, access to all the mechanisms that enable it to attract and undertake good reserch; that is, a scholarly environment.

The process of growing new ventures in a commercial sense from such backgrounds may be likened to any natural process of growth; in fact our experience leads us to believe that the more natural the process the healthier the offspring. If universities are to maintain intact their reputation for excellence in scholarship, then there have to be fair and equitable methods of achieving transfers to technology from such research teams.

And yet the difficulties should not be underestimated -- resources, legal, methodology, ethical issues and incentives. Most universities face reduced finances over the next few years, particularly in the industrialized world. And yet the world needs, more than ever before, the products that universities have to offer: well-found research laboratories, skilled technical support staff, able teachers, and teams of dedicated research staff backed up with able administrators.

Legal barriers are not insurmountable but must be recognized: the seeming incompatibility of the law of master and servant and freedom to publicize; the protection of industrial know-how by secrecy agreements as against the free interchange of ideas created within good academic institutions; the competing rights of ownership of intellectual property.

Moral dilemmas are not imaginary. In the thick of negotiations, when a new and more attractive offer becomes available, do you drop existing negotiations and take the new offer? When industrial friendships have been nurtured over some time do you take your ideas to a new client with a deeper purse? Having struck a know-how deal are you then free to undertake research with known competitors or companies in the same or related fields? Do you allow academic colleagues to undervalue the support given to their endeavours in order to take up the first offer they receive to fund their ideas or do you cast aside their interests when negotiating industrial deals that will bring in scarce resources to your institute? Do you sell on the home market and ignore the overseas markets or vice versa?

Against a tight money policy institutions find themselves forced into hardening their attitudes but it is essential to evolve an ethical code; one fitting the new and unfamiliar territory in which both academic institutions and industrialists find themselves foraging. And one which all sides recognize as fair and workable in a competitive market.

Here it has to be recognized that most of the negotiating advantages are initially with the industrialists. They have the resources, they often have the time to wait whilst research monies run out and academic institutions become desperate for funding, there is a tradition of academics giving away ideas through publication in their favour, and there has been an inability by institutions to set up or manage a technology transfer system.

It has also to be recognized that there has been a lamentable failure from both sides to recognize what is at stake and what needs to be done. So often when it comes to negotiations for a licence it quickly becomes apparent that, whilst there is an idea and even a prototype laboratory-scale working model, scaling that up to a high volume production operation needs a further major input from both sides. And yet again conflict arises; academics do not always see it as in their interests to spend time debugging industrial prototypes and scaling-up from a laboratory to a pilot plant and then a full-scale plant. What incentive is there for a scientist in search of peer appraisal to maintain a resarch team to devote valuable time to production problems, and what industrialist can afford to invest in an expensive research team for what appears to be an open-ended project taking into account the profit criteria by which he works?

What are the incentives? It is unrealistic to believe that by squeezing universities' finances governments will force successful marriages between academia and industry; the offspring from such shotgun affairs will be little more than mutants burdening the economy (national and international), industrial misfits rather than properly fed and clothed progeny strengthening the ties that must be evolved for tomorrow's world.

How then are universities to handle their problems? Whilst the bright 18-year-olds of today make up the vast majority of the undergraduate populations, there has to be a new style of entrant at the diploma and postgraduate levels for relevant academic study and, very importantly, an interchange of staff betwen industrial and university laboratories and workshops to enable problem-solving to be tackled at all levels -- senior management, middle management, skilled technician and supervisory -- all adequately supported with space, equipment and services.

In some licensing situations our university has negotiated renewable options during which industrialists have sent a member of staff to the university to work in the laboratory and learn the techniques and processes of producing prototype products before completing full licences. Whilst this is quickly recognized by the industrialist as a very economical way to evaluate a scientific development, it has placed some unwelcome burdens upon the university staff and has been difficult to facilitate. At the same time, the industrialists are not willing to allow academics into their environs until they have run into great difficulties and have often wasted considerable resources trying to resolve development problems alone.

We see one answer to this in the creation of Science/Research Parks and have embarked upon potentially the largest in the United Kingdom -- a facility to fill the "middle ground" between university creativity and industrial application. This we see as deserving more attention, but it can only succeed given proper interchange of people and ideas; a one-way flow is insufficient.

So far as negotiations are concerned attitudes vary, with many who are practiced in the art of negotiating preferring to work independently of the inventors. Their attitude has to be respected. Nonetheless, we have chosen a different approach. For an academic colleague new to the world of business there are the dangers of the unknown. A team comprised of legal, scientific, patent, finance and administrative expertise is a formidable force and although it takes a great deal of time to create rapport between those parties, once established they can react with astonishing speed in support of the university and its staff. But the overriding priority is to create a sense of trust between this team and the academic staff concerned.

Consider the administrative advantages. A senior Administrator can move rapidly from one team to another without the burden of attempting to be an expert in every scientific subject. At each set of negotiations the relevant scientist is there, armed with the facts that will protect the institution from being out-maneuvred by a clever opponent able in the manipulation of statistics and data and all the reasons why the idea might be sound but industrially unworkable. As the technical experts from both sides grapple with the problems the administrator, with experience in resource allocations, formulates a picture of the resource needs to achieve success -- time, space, equipment, expertise from other colleagues, funding.

Often at this stage of discussions it will become apparent that more research is required before the industrialist has a marketable product. This is particularly so in the fields of biotechnology and materials science. If a patent licence is under negotiation, and if the institution is to achieve technology transfer, it is important that the limitations of resources in the inventor's institution are recognized. Far too often scientific breakthroughs are lost, I suspect, because of an unwillingness to draw in resources, skills and know-how from other institutions and businesses.

What inhibits these breakthroughs? Largely I think the potential frustration of losing control and direction of the thrust of an idea. Unless a breakthrough is of major significance, it is unlikely to be attractive to a mix of industrial companies and academic institutions with differing criteria to pool their resources and ideas, and this is particularly so where interdisciplinary collaboration is required.

There is probably as good a record of collaboration betwen universities around the world as in any field today. But whereas the scientists move from one university to another during their career development, how many move into and out of universities and industries? To meet people who have progressed their careers in such a way is, however, an enriching experience.

A factor now being examined by the U.K. Government is the disincentive of loss of pension rights. Very few career paths enable scientists and management to ignore the benefits of accumulating pension benefits, and yet the removal of pent-up frustrations and release of new energies from a freer movement of good scientists, engineers, and managers between industry and universities can as yet only be imagined.

To encourage technology transfer there often has to be people transfer, if only on relatively short-term projects, of one to three years for instance. The exceptional achievements of collecting an international team of scientists at CERN, and Abingdon where the JET scheme is being pioneered, can hardly be taken as models for the effective transfer of most of the technology under development within universities. And yet are not there lessons to be learned? Are we able to offer affordable living accommodation in appropriate locations? Is there scope for mini-scale villages close to universities in support of research and science parks? The creation of environments where colleagues can be at home with one another, and their children can have continuity of education in multinational and multilingual, university-based schools? There will have to be a much more enlightened attitude towards the ownership and development of intellectual property before any such halcyon ideas become reality. But if they are not fostered by Government will they happen? Multinational companies depend upon the creation of such an ethos to hold onto their creative staff. How long will it be befoe mixed university- industrial campuses are realities?

Clearly these improvements cannot be made overnight but if these problems are recognized as barriers to the effective transfer of technology and are removed, then they could become reality in the future. Many of the ingredients exist within the newer universities, which were set up with a technological bias and appropriately located, close to established resources and with good communications and industrial and commercial linkages. It has to be acknowledged that whilst many scientific breakthroughs occur against all the forecasts, and sometimes contrary to the objectives of the main concentration of resources, it is highly improbable that the best scientific endeavour will be located away from the best resources; there must be available expensive scientific equipment, well-found laboratories, and a creative ethos if ideas are to emerge; Crick and Watson did not work in a resource desert even if their ideas isolated them from their colleagues.

Universities need an incentive to devote scarce resources to technology transfer, resources in the forms of people, space, equipment, time and money. It follows that if no clear advantage can be seen, academics will not wish to waste their time in attempting aimless technology transfer. What then, are the forms in which technology is available for transfer, for experience suggests that they are not easily recognizable. The range is as wide as the needs of industry and society, at least in potential. The extremes are the shop-window ideas available to buy outright, such as devices, software, publications, consultancy on the one hand and the total dedication of major teams, space and equipment over long periods of time on the other.

The mechanisms to deal with that range of problems, or rather the lack of such mechanisms, is where the troubles begin. I think certain basic rules have to be accepted before clear guidelines can be drawn-up; e.g. profits belong to industry and commerce, not the public sector or universities. There is far too much confusion as to the purpose of, justification for, and entitlement to profits.

Profits bring benefits to the public sector through the mechanism of taxation, thus it is to everyone's advantage to achieve high levels of profitability over long periods of time. For this reason private industry should not be saddled with costs that will force up unit prices and make sales prices uncompetitive.

Conversely, ideas do not achieve their just rewards. There is an entrenched attitude in the private sector that buying a piece of research gives automatic ownership to all new ideas deriving therefrom. This is a serious barrier to technology transfer, for it would be naive to think that by securing legal rights in a contract an industrialist is securing technology transfer. In many cases it has probably strangled a good opportunity at birth. Unless the scientist retains a personal interest along with their institutions, and the two together form a vital partnership in technology transfer, there is unlikely to be any effective transfer in many cases.

A transfer of a patent does not transform laboratory experience into real usable technology. To achieve that there has to be a tie binding the parties in mutual interest and it has to be said that industrialists are not always good at recognizing and accepting new technology in the form of a continuing contract or licence. But because of the worries and anxieties on both sides, the formulation of contracts takes an inordinate amount of time. Contracts completed rapidly can be taken as a sign that either the academic institution has yielded to pressures to take some short-term funding and ignored the need to form long-term, strong links, or that the contract is not worth the paper it is written upon.

There is no advantage to the nation as a whole in moving the costs of financing universities from government to industry and commerce. Attempts to do so can create new fashions and window dressing but mask longer term dangers. Whilst some pressure upon academic institutions to become more relevant and realistic is healthy, too much can undermine and damage the nation's most important asset: its ability and facility to educate and train its future generations. There is no incentive to industry to fund under-resourced institutions and the pressures upon these institutions to survive are likely to encourage them to accept expedient short-term financing from industry at the cost of wasted, unfruitful work that will discourage closer collaboration. It would be tragic, for instance, if many of the current government schemes which are beginning to encourage real collaboration between universities and industry were stifled at birth.

If only these basic philosophies could become acceptable it would remove one of the greatest threats to closer collaboration -- a new generation of specialists planting themselves between the university academic staff and researchers and the industrial achievers. The only interface necessary should be in the form of the administrative staff who must address themselves to the financial, legal, and psychological barriers of closer collaboration. This can be encouraged by administrative career development encompassing the public and private sectors. That is not to suggest that legal and patent experts can be omitted but that university administrators and academic staff have to learn how to ask for and receive advice and evaluate that advice. That needs a great deal of hard work and flexibility.

One of the most daunting and time-consuming problems faced by young academics who wish to ensure that their ideas and know-how are transported from their research laboratories to the market place is that of funding. In the U.S.A. the venture capital market has evolved from an initiative from the banking sector, but its equivalent has not yet been perfected in the United Kingdom. And this surely has to be as much an administrative problem as any other.

It is not in the longer term interests of universities to see their bright staff burned in the heat of business. Benefits have to be mutual. Industrialists should not be afraid to submit their products and processes to searching scientific critiques and graft onto their existing technology new ideas that will be seen as a process of evolution from tried and tested ones into second, third and future generation ones. Why not in fact subject problems to mixed university/industrial workshops, where a full exposure is made and from which a process can evolve having heard from one another through a mutual examination of problems.

Universities have the skills and talents to run very good short courses which a mix of industrialists attend. How successful would it be for a company to approach a university and thrash out its technology and research strategy for the next three years or so, to expose its management to the full glare of scientific critique?

Such workshops would need careful pre-planning, but could add a richness and freshness to industrial planning that would justify such experiments. Whilst large industrialists have the potential from within their organizations to bring about such groupings, the small- and medium-sized companies rarely have the in-house expertise needed for success.

Before attempting to summarize, let me give some thought to incentives for academic staff. Let me at once explode a common myth [illegible] staff do not work in universities for an easy life. The endeavour and sacrifices required to survive and achieve personal growth have to be experienced to be understood, as in most walks of life.

What is so often misjudged as naiveté on the part of academics who willingly divulge their learning is a difference in motivation. If technology transfer is to be worthwhile, there has to be more incentive to adapt to commercial practice and vice versa. There have to be more opportunities for leading researchers to take directorships in embryo companies and joint ventures without being cast adrift by their institutions. If they are to join in willingly, there has to be trust on both sides and this will inevitably take time, backed up from both sides with resources and goodwill. Personal shareholdings should not be looked upon as a method of getting the upper hand by either side, but as a means of communicating and bringing a sense of realism into the venture.

I have not come across greedy academics in my institution and believe them to be, if they exist, a small -- an unrecognizably small -- minority in universities. What I have encountered is a willingness to learn and a remarkable ability, as would be expected from highly trained minds, to progress rapidly up the learning curve and, given help and guidance, an ability and desire to achieve technology transfer. As with any volatile and idiosyncratic material, great patience and care is needed to be successful, and that I do not consider has, by any stretch of the imagination, been achieved as widely as the potential that is there for the asking.

ABSTRACTS

CASE STUDY OF THE UNIVERSITY OF UPPSALA: TO PUT NEW WINE IN OLD BOTTLES

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In Sweden, like in many other countries, the economic decrease at the end of the 1970s imposed financial constraints on the universities. A system of annual retrenchment of state funds, 1-2% per year (the "cheese slicer" principle) was introduced. Simultaneously, the need to strengthen the research policy and provide new funds for university research was realized. The result was a dualistic economic approach to the universities from the State Authorities: decrease of funds for undergraduate education and increase of research funds. With the deepening economic crisis the "piece of cake" principle was invented. The supply of and the demand for different kinds of education (and research) were to be examined and concentration, profileration or fusion would be recommended. This pattern was, however, found to be almost impracticable -- for political reasons.

This case study gives a rapid survey of the changing approach to the economy of higher education and research in Sweden. A brief historical survey serves as a background for an analysis of the future: which steps would be taken in order to bring about increased quality and more efficiency in a time of tightening. How to get new wine in old bottles?

MEASUREMENT OF INSTITUTIONAL GOAL ACHIEVEMENT A CASE STUDY

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There has been a tendency in the past for some higher education institutions to measure performance and quality solely in terms of inputs to the institutions (e.g. staffing ratios). More recently, however, pressures on resources and emphasis on greater accountability have resulted in institutions placing more emphasis on attempting to assess their performance and evaluate their output. This presents serious practical problems since universities pursue a range of objectives which are sometimes diffuse and whose relative importance may be unclear. It is also unclear what criteria should be used to assess the degree to which a goal has been achieved and the weight which should be attached to them. This paper describes the research that has been carried out on a number of Middle Eastern countries to shed light on the above questions.

THE IMPACT OF INSTITUTIONAL RESEARCH ON EDUCATION DECISIONS
THREE EXAMPLES WITH APPLICATIONS

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The economy of the Danish universities got a new allocation system in the beginning of the 80s. For educational activities, it was based on performance indicators of external and internal and quantitative and qualitative nature. It has been necessary to develop new measurement techniques to respond to the new public demands and to produce the prerequisites for decision-making inside the university. The "flow of university students", the "employment development", and "the unemployment as well-box" are three examples of new IR. The methods and results are commented on and the applications are placed in a general dynamical frame for university management including the labour market, the Ministry of Education, and feedback relations.

RESOURCE ALLOCATION IN A DECREASING ENROLLMENT ENVIRONMENT

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Resource allocation procedures which work with an increasing enrollment are hard to implement when enrollments start declining because of the differential effects of enrollment changes on fixed, semi-variable, and variable costs. The paper describes the main features and results of an integrated planning and budgeting system developed to allocate resources in a fiscally constrained environment with a view to enhancing the efficiency and effectiveness of the institution. This is done by relating the allocation of resources to unit objectives and institutional priorities through the intermediary of the activities conducted by the operational units.

MATHEMATICAL AND STATISTICAL MODELLING:
THE CAREFUL PATH BETWEEN ENTHUSIASM AND SCEPTICISM

Claude Cossu, Professor
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The aim of this paper is to show how microcomputers can be helpful in statistical analysis and mathematical modelling for forecasting and decision-making:

1st step: Data must be - relevant
- homogeneous

2nd step: Models must be - effective (constraints/goals)
- cost-efficient
- reliable

Examples of the following are included:
- time-series analysis (student credit-hours);
- multilinear regression (simple costing model);

- ELECTRE/MARSAN (multicriteria selection program)
  (choice between new educational products);
- catastrophe theory (finance and uqality of the institution).

PLANNING FOR QUALITY AND EFFICIENCY IN HIGHER EDUCATION

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The choice and applications of planning methods are dependent upon planning purposes. Planning in the closing years of the 20th century thus will require different planning concepts and techniques because the purposes of planning have changed. Two crucial planning objectives for institutions of higher education are improved quality and increased efficiency. This paper addresses the particular features of quality and efficiency as they relate to institutional and program planning. It considers the difficulties of planning for improved quality in an era when there are high expectations for increased efficiency in the use of limited public resources. Also considered is the relevance of sequential (rational/analytic) planning models as opposed to transactional (political/deliberative) models of decision making in higher education.

FLEXIBLE SPENDING OF FUNDS AND BUDGET-MAKING COMPETENCE IN THE UNIVERSITIES

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This paper gives an overview of the accounting system and budget control processes in German universities and discusses the problems of retrenchment in this context. Centralized and decentralized control processes are compared. Examples of different systems available on microcomputers are presented: e.g. EDP, MULTIPLAN. A comparison is made between spreadsheets and cost-accounting systems for German universities. Some suggestions to increase the flexibility of the decision-making processes within the German universities are given.

MANAGING FINANCIAL COMPRESSION: ONE UNIVERSITY'S EXPERIENCE

Cynthia Hardy, Assistant Professor of Management, McGill University
and Charles H. Bélanger, Director of Institutional Research,
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This paper examines how one university has managed cutbacks. The study, which was part of a larger comparative study, describes the extent of cuts, and McGill's response. It examines the outcomes of this approach, the reasons behind it, and the constraints and facilitating factors that helped shape it. This analysis clearly illustrates the interplay between the environment, the institutional context, and the retrenchment process. Finally, conclusions are drawn regarding the theoretical implications and the extent of the success in this particular example.

ADAPTATION MODES FOR THE STATE LAND-GRANT UNIVERSITY DURING CONDITIONS OF DECLINE

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Based on the major recommendations of Clark Kerr's blue-ribbon panel on the future of a state land-grant university, this study examines the modes of organizational adaptation available to an institution in the midst of conditions of decline. The four approaches of population ecology, life cycles, symbolic action, and strategic choice are presented to identify the most effective adaptation strategies for administrators. A final section suggests that successful adaptation requires administrators to become Janusian thinkers who can pursue mutually contradictory aims simultaneously.

PROGRAM REVIEWS, PLANNING, AND DATA BASES: THE EXPERIENCE OF A LARGE UNIVERSITY

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Many universities in North America have recently placed emphasis upon the interrelated functions of program review, planning, and data base development. Program reviews provide information relevant to planning, improvement, and justification, but review procedures vary considerably in administration, scope, frequency, purpose, type, and membership of review committees. At the University of Alberta, systematic, continuing program reviews of academic and administrative/support units commenced in 1980, concurrent with expansion and improvement of data bases. Its procedures involve writing of a comprehensive self-study report and reviewing by a committee composed of internal and external members. Recognition that effective overall planning could not be based solely upon program reviews led recently to more comprehensive planning activities.

USE OF MICROCOMPUTERS BY A COLLEGE DEAN

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The growth of microcomputers in higher education is too rapid to maintain an up-to-date inventory of either software or hardware. Educational leaders speculate that decision-makers will soon have personal computers on their desks along with the telephone, dictating machine, and the Scotch tape. The vital question for institutional researchers is whether decision-makers will have the ability, the interest, and the time to use computers to interact directly with institutional data. To explore this question, a college dean and an institutional researcher worked together from their different perspectives to accomplish some savings in personnel services' funds by designing an improved allocation procedure. Both the Dean and the institutional researcher kept separate logs to record their views of the objectives, the problems, and the actions which were taken. The results show how the microcomputer was used to help with the analysis and to illustrate the problems decision-makers have with microcomputers.

CASE STUDY — UNIVERSITY OF SURREY: AFTER RETRENCHMENT — QUALITY AND EFFICIENCY

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Background data are presented on the size and nature of the University of Surrey as well as the effects of reductions in government funding, restrictions on student entry, and the retirement of 25% of the academic staff. Developments in personnel policy and the growth of self-financing activities are presented, and new initiatives (e.g., a Research Park, new degree courses, technological transfer network) are discussed. Several future problems such as staff age, accountability, review procedures, lack of development resources, diversification of activities, and collaboration with other institutions are also explored.

TECHNOLOGY TRANSFER FROM UNIVERSITIES INTO INDUSTRY

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Fair and equitable methods of achieving transfers of technology are required. There are many difficulties, including lack of resources, legal obstacles, methodology, ethical issues and the need for incentives. Most negotiating advantages are with industrialists and there is a failure on both sides to recognize opportunities and organize effectively. A team approach is required in universities, bringing legal patenting, financial and administrative expertise to the assistance of academic colleagues. More opportunities are needed for younger academic staff to obtain personal rewards for their work, but this has to be based on trust between the universities and their staff, backed up with resources and good will.

INDUSTRIAL CHANGE AND UNIVERSITY SYSTEM: THE EFFECTS OF THE NEW GOVERNMENTAL FUNDING PROGRAMS TO DIRECTED RESEARCH IN THE UNIVERSITIES OF QUEBEC (CANADA)

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The desire of the governments of Quebec and Canada to re-create prosperity have initiated new research funding programs oriented primarily toward applied research. The provincial requirements have had three consequences: first, an important proportion (70.2%) of funding is now allocated to directed research; second, the high technology research is conducted outside the universities; and third, the universities are now just a part of a global creation process under the government's control. Even if the effects of the federal decisions are a bit different, they also contribute to the weakening of the university system, especially because strategic research will be carried out in national research centers without any formal links with universities. As a result, governmental wills are pushing universities into a marginal situation.

ISSUES IN THE UTILIZATION OF KNOWLEDGE

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Western culture is committed to "rationality" in decision-making. Despite the prevalence of this value, the reality of decision-making does not always conform to the ideal. This paper examines the question of information use - - why does it not happen? What theories are there on encouraging it to happen? What practices should be followed to increase the use of information? Four perspectives on the question of information use are examined: the rational model of decision-making; theories on knowledge transfer, innovation, and change; theories on the practice of consulting in organizations; and finally, cognitive theory. Building on this base, the paper then discusses certain special problems posed by the use of computerized mathematical models as the type of information being transferred.

APPLYING STRATEGIC PLANNING IN ACADEMIC DEPARTMENTS: TAKING CHARGE OF CHANGE

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This paper first presents a model that outlines the structure and process for relating strategic planning to the development of action plans and budget requests at the department level. Second, a five-step procedure will be described to help academic departments answer the basic questions of strategic planning. Finally, a summary of the implementation of this strategic planning process in academic departments at three different institutions and a discussion of the uses made of the outcomes of this process for department plannning and budgeting purposes will be given.

THE USE OF BIBLIOMETRIC DATA AS TOOLS FOR UNIVERSITY RESEARCH POLICY

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At the State University of Leiden a study was performed on the potential of quantitative, literature-based (i.e. bibliometric) indicators as tools for a university research policy. As a subject of evaluation we analysed the research performance of two large Faculties (the Faculty of Medicine and the Faculty of Mathematics and Natural Sciences) during the period 1970-1980. Publication and citation-based indicators were calculated for all research groups, involving data on some 6,700 publications and 42,000 citations to these publications. Results were analysed and discussed with researchers from the Faculties involved. In this paper we present the major experiences and conclusions from this study.

BUDGETING PRINCIPLES FOR UNIVERSITY ADMINISTRATIONS - DANISH EXPERIENCES

Peter Plenge, Head of Administration
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The paper reports on a recent investigation in budgeting methods for central administrations at institutions for higher education in Denmark. The investigation was conducted by a group of administrators commissioned to propose a new budgeting system for the university administration.

The paper covers the following issues:

- the interface between centralized and decentralized administrative functions;
- how to compare differently organized administrations at different institutions;
- advantages and disadvantages of quantitative budgeting methods (formula-budgeting);
- the budgeting-process as an interplay between qualitative and quantitative factors.

The conclusion of the paper is that qualitative considerations must play a major role in the budgeting of university administration, although quantitative analysis can be used to facilitate the budgeting procedures.

PROGRAM QUALITY — DEFINITION, ASSESSMENT, ENHANCEMENT

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In some publications in the Netherlands fear has been expressed that recent government measures related to retrenchment are threatening the quality of educational programs to such an extent that, even when retrenchment has come to an end, the remaining quality of the programs may be seriously questioned. However, irrefutable proof of sufficient program quality is impossible, and cannot be asked from universities. It is argued that the best way in which institutions may meet their responsibility for program quality is a constant concern for quality enhancement. A simple definition for the concept of program quality is formulated in the context of the enhancement of the quality of educational programs. With the help of this definition the relation between quality enhancement and the structure of the planning process and allocation models is discussed.

APPLYING ROBUST REGRESSION TECHNIQUES TO INSTITUTIONAL DATA

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Regression techniques are used frequently to analyze the relationships between university activity variables and the needs for different categories of resources. The ordinary Least Squares method (LS) has the disadvantage of being very sensitive to outliers. As an alternative the least median of squares (LMS) technique, which can resist a large fraction of contaminated data, is discussed. To demonstrate the advantages of LMS, the parameters of some regression equations estimated some years ago by means of the ordinary least squares and describing the needs for non-academic staff in a university will be reestimated by means of this robust regression technique.

COLLEGE AND UNIVERSITY RETRENCHMENT: ITS IMPACT ON NON-ACADEMIC REVENUE SOURCES

Edwin R. Smith and Ben J. Tuchi
West Virginia University

Several years ago, West Virginia instituted an administrative policy requiring all auxiliary service units to be fully self-financed. This paper reports on several findings of a study commissioned to investigate the impact of this policy on several of the auxiliary service units. The report includes a discussion of both anticipated and unanticipated consequences of this decision. Suggestions and recommendations for administrative strategy necessary for implementation of such a policy are also included.

THE NATURAL HISTORY OF A REORGANIZATION PROJECT

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This paper presents a case study of a reorganization process in the subfaculty of the social-cultural sciences in the University of Utrecht. In April, 1982 the administration required a 10% decrease in teaching and research staff and the appointment of 20% more temporary staff. The subfaculty appointed a reorganization committee to fulfill these demands. The situation of the subfaculty and the transformational strategy are outlined and a discussion is made of the consequences of reorganization.

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